

DERMATOGLYPHICS IN DIABETES MELLITUS OF TYPE 2 (T2DM) OR NON-INSULINDEPENDENT

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Abstract. Aim. The study is aimed to analyze the pathology of palmary dermatoglyphics of a group of population from Moldova (North-East part of Romania). **Materials and methods.** The study was performed on a group of 190 patients (60 men and 130 women), affected by diabetes mellitus type 2 (T2DM), aged between 40 and 82. The installation of the disease has occurred between the age of 35 and 80 years of age. **Results.** The results reached in the analysis of the 380 dermatoglyphic files have been compared with those recorded (by the author) for T1DM - affected patients, and for a reference sample from the same geographical region with the former ones. The observation to be made is that, regardless of the age of the malady's onset or of the afferent complications generated by T2DM in time, the patients evidenced a palmary dermatoglyphic picture with a deep pathological charge, suggestively illustrated by 10 important distortions or anomalies carrying profound medical significance. Associated in various combinations, between 3 and 6, in the palmar print of each affected person, such anomalies recorded values sensibly different from those of the reference sample, being quite close to the behavior of T1DM - affected patients, in whom - actually - the clinical manifestations of the malady are (generally) similar. If, by its 10 individual palmary distortions T2DM is highly resembling T1DM, once they might be utilized as „markers” for a precocious diagnosis of the persons in whom the risk of T2DM is quite high, two important deviations at the level of the whole palmary picture permit the differentiation of the two forms of diabetes for further possible populational studies have been evidenced. They refer to *the sensible diminution of the pattern frequency in the interdigital space IV, which led to a different positioning of this compartment in the classical distribution formula*, namely: $III > Hp > IV > Th/I > II$ instead of: $IV > III > Hp > Th/I > II$. **Conclusions.** Distorsions might be markers in the individual diagnosis. Dermatoglyphic test represent one of the procedure for tracing diabetes in population.

Key words: palmary dermatoglyphics, distortions or anomalies, pathology, type 2 diabetes mellitus (T2DM)

Rezumat. Scop. Scopul studiului a fost analizarea patologiei dermatoglifelor palmare pe un lot de persoane din Moldova (Nord-Estul României). **Material și metode.** Studiul s-a efectuat pe un lot de 190 pacienți (60 bărbați și 130 femei) diagnosticați cu T2DM, cu vârsta cuprinsă între 40 și 82 de ani și cu un debut al bolii între 35 și 80 ani. **Rezultate.** Rezultatele obținute din analiza celor 380 fișe dermatoglifice au fost studiate comparativ cu cele constatate de autor la pacienții cu T1DM și pe un eșantion martor din aceeași zonă cu afecțării. Se constată că, indiferent de vârsta la debut a bolii sau de complicațiile aferente generate în timp de T2DM, pacienții prezintă un tablou dermatoglific palmar cu o mare încărcătură patologică, sugestiv ilustrată prin 10 distorsiuni sau anomalii cu profunde semnificații medicale. Asociate în diverse combinații între 3 și 6 în amprenta fiecărui afectat, pe ansamblul eșantionului aceste anomalii înregistrează valori care se distanțează sensibil de cele ale lotului martor, în schimb,

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se apropie mult de comportamentul pacienților cu T1DM, la care manifestările clinice ale bolii sunt, în general, asemănătoare. Dacă prin cele 10 distorsiuni palmare individuale T2DM se apropie de T1DM, ele putând servi ca „markeri” în diagnosticarea precoce a persoanelor cu risc pentru T2DM, pe ansamblul tabloului palmar s-au evidențiat două importante abateri de la normalitate care permit departajarea celor două forme de diabet în posibile studii populaționale. Ele constau în *diminuarea sensibilă a frecvenței de model în spațiul IV interdigital* care a condus *la schimbarea poziției acestui compartiment în formula clasică de distribuție* în sensul: III > Hp > IV > Th/I > II în loc de IV > III > Hp > Th/I > II. **Concluzii.** Distorsiunile pot fi markeri în diagnosticul individual al bolii. Testul dermatoglific reprezintă o altă procedură de identificare a diabetului în populație.

Cuvinte cheie: dermatoglife palmare, distorsiuni sau anomalii, patologice, diabet zaharat tipul 2 (T2DM)

INTRODUCTION

Nowadays, it is unanimously recognized, that diabetes, generally, and type 2 diabetes, especially, represents a major threatening of the public health condition worldwide, if considering the epidemic ratios recorded at planetary scale seen as dramatically increasing all over the world (4, 6, 19, 21). In 2030, it is estimated that the total number of diabetes - affected people will reach 366 millions. This idea is also supported by the fact that, annually, 3.2 million persons die of diabetes, 8,700 die every day, 6 persons every minute, which explains the anticipations provided by World Health Organization (WHO), International Diabetes Federation (IFD), European Association for the Study of Diabetes (EASD) and European Diabetes Care Predicators (EURO DIAB) according to which, in the future diabetes will be on the top of the mortality and morbidity causes along with cardio-vascular diseases and cancer (20, 21, 22).

Mostly affected by this epidemic of the 21st century will be the under developed and the developing countries which will take over probably about 80% of the

new cases of diabetes, mainly for the 35-65 years segment of age.

As to the developed countries, in the following 25 years to come, the number of the cases of diabetes recorded now will get double, affected people being persons - 65 years and over (7, 19, 20, 22).

The rapid evolution of **diabetic pandemy**, especially of type 2, which is the most frequent one among all forms of diabetes known up to now, is mainly caused by the general aging tendency of the population, rapid social and cultural changes, rapid urbanization, modification of the life style and, implicitly, of the diet, etc, all these elements generating stress, which is a key factor in provoking the malady (20). According to the estimations of the Eurodiab Association, the epidemy of diabetes (T2, especially) will become more severe in Romania, as a consequence of globalization, manifested in the new life style adopted by most of the people, lack of physical activities, hypercaloric diets, contributing to a considerable extent to the appearance of the first clinical signs of the malady (4, 6, 20). About 50.000 new cases of T2DM are

recorded, annually in our county of which 47% with HTA, 55% with dislipidemias, 37% with cardiovascular diseases, 22% with neuro- or polyneuropathies, 12% with retinopathies, 5% with nephropathies, constituting irreversible complications induced by diabetes type 2.

Unlike T1DM, which is an autoimmune malady with a sudden and tumultuous debut, at early ages (childhood and adolescence), T2DM has a much slower and non apparent debut, or even masked by another affection generated in time being also discovered much later, after the ages of 40 (16, 17).

According to the definitions supported by the latest progress recorded in the field, T2DM constitutes a ***profound and complex disorder of the general metabolism, in which there are involved - in variable ratios - the deficiency in insulin secretion of the beta - pancreatic cells, on one side, and the resistance of the peripheral (muscular, adipose, hepatic, etc.) tissues in employing insulin for transporting glucose in blood and for its subsequent transformation in glycogen (the so called insulin-resistant), on the other side*** (5, 6, 21).

The insulin-secreting deficiency of the beta-pancreatic cells has multiple causes, a very important role being attributed to: ***the reduction in the mass of such cells with 30-40%***, which may be either a hereditary cause or it may be caused by a prolonged hyperglycemia, leading to the death - through necrosis or programmed apoptosis - of some of the beta cells; ***the modification of the oscillating***

pattern of insulin secretion in persons liable to T2DM - risk, a parameter that might be employed as a marker in their precocious detection; ***to an increased blood proinsulin ratio, as due to its more reduced conversion into insulin, with age*** (4, 6, 8,11).

Sometimes, such deficiencies might generate modifications in the sensitivity of the peripheral tissues in utilizing insulin as a sort of insulin-resistance (the second side of T2DM).

Nevertheless, the latter one may be genetically conditioned as well (a proof of this being that T2DM is more frequently occurring in persons with a positive diabetic history in the family), or by an excessive accumulation in blood of the free fatty acids and by their subsequent deposition both in beta insulenic cells and in the muscular tissue, as triglycerides, which impedes the transport and retention of glucose with 40% (*versus* the normal value) and the synthesis of glycogen - with 60%, thus facilitating the death, through apoptosis - of some muscular cells and sensibilization of the remaining ones in utilizing insulin, sometimes with steatonecrosis of the myocardium (12). Thus, the risk for T2DM increases with the increase of the bodily weight and abdominal obesity.

From a hereditary perspective, studies developed on twins or on families with one or more members affected by T2DM, along several successive generations, evidenced an ample genetic charge of T2DM, suggestively illustrated by a high index of the malady's concordance in monozygote twins (about 100%), as

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well as by a higher risk of its appearance in once removed relatives of the affected persons - which is 20-40% higher *versus* only 2-6%, which are the values found in the normal population (4,5,11,18).

As in the case of T1DM, the genes responsible for T2 DM are multiple, even hundreds, some of them being responsible for the sensitiveness towards the malady, others for its genesis, while others assure the organism's resistance to T2 DM (4,18). Genes' action is cumulative and selective consequently, some of them being responsible for the deficiency in insulin's secretion, others for the reduction of its biological action or for the peripheral insulin-resistance, in spite of the fact that the mechanism of these multiple genes is not clearly known, as the mechanism of transmission to descendants still non-elucidated.

For the situations of T2 DM transmitted exclusively through, maternal line, a significant part in its genesis is played by the mitochondrial DNA, which encodes an important number of proteins with genetic defects responsible both for the manifestation of deficiencies in insulin secretion, and for the sensibilization of the peripheral tissues in the utilization of this hormone for assuring insulin-resistance (5, 6, 18). Considering all the above observations, and also the well-known relation of dermatoglyphics with the malady, the present paper is devoted to the study of these morphological characteristics, on a group of subjects suffering from non-insulindependent diabetes mellitus, all coming from Moldova (2, 3, 13).

Consequently, the author will try to demonstrate the existence or the absence - in the dermatoglyphic picture of T2DM patients - of some characteristic malformative sketches, as well as the ratios they record in the group taken into study.

MATERIALS AND METHODS

In the Center for Diabetology of the „Sf. Spiridon” University Clinical Hospital of Iași, there have been investigated dermatoglyphically 190 patients (60 men and 130 women) suffering from T2DM, with ages between 40 and 82 years (95% of the men and 91% of the women being older than 50), from whom 380 palmary prints have been taken over. The individual inquiry of each affected person evidenced that the youngest age at which T2DM had been discovered was of 34 years in women and 35 years in men, while the oldest ones - 79 and 80 years respectively. It is mentioned that, in 60% of the women and in 63% of the men the malady occurred between 50 and 65 years. In 8.33% of cases in men and in 20% of the women, the non-insulin-dependent diabetes started with specific clinical symptoms, such as: asthenia, fatigue, dry mouth, polyuria, etc, in 33% of the men and 38% of the women the T2DM being discovered by routine tests. The rest-up to 100% were diagnosed by the physician, as precarious health conditions, such as: AHT (arterial hypertension), ischemic cardiopathy, myocardium infarct, atrial fibrillations, obliterant arteriopathy of the inferior members, chronic hepatitis, hepatic cirrhosis, osteoporosis, lowering

of visual acuity, neuro- or polyneuropathy, etc, most of them being secondary affections generated by an atypical, inapparent diabetes, discovered much later (if considering the moment of its debut). The same individual inquiry showed that, in 35% the patients (39% women and 30% men), T2DM is hereditary.

For all evidenced dermatoglyphic pathology, there have been also analyzed sexual dimorphism, the bilateral differences as well as their uni- or bilateral disposition in the carriers, which illustrates the extent to which the patients are affected from this perspective. The results obtained have been compared with those recorded on patients suffering from insulin-dependent diabetes mellitus coming from the same region and also with those of a reference sample from Moldova (North-East part of Romania) (13, 16, 17).

The methods applied are those currently employed in investigations of pathologic dermatoglyphics (2, 3, 9, 13, 15).

RESULTS AND DISCUSSION

The individual analysis of palmary dermatoglyphics, to which the present study has been devoted, permitted evidencing of 10 important sketches or malformative signals with deep pathological significance, which occurs grouped, in a number ranging between 3 and 6, in various positions and combinations, in the palm of each patient. At the level of the whole group, each of these distortions or anomalies should attain extremely high ratios,

comparatively to the normal values, from which they are significantly different (table 1). Part of these important distortions or anomalies bearing grave clinical implications and have been also recorded in other European groups of diabetics (9, 13).

The observation has been therefore made that most of the T2DM - affected patients (55.79%), the feminine series, especially (58.48%) - are carriers of the **partial suppression of line C (Cx)** which, as a formation bearing severe pathological implications, reach an average ratio of 36.58% (38.07% in women and 33.48% in men) occurring especially on the left palm, in both sexes (table 1) (2, 13).

In a decreasing order of their frequency after Cx, more frequently anomalies occurring in the study group are the followings: **arrangement of the papillary ridges from Th/I in a dense and very dense network**, with an average weight of 31.84%, being only less frequent in women and mainly on the patients' left palm; **the presence of 2, 3 or 4 triradia (tt't'', etc.)** in the same palm of the patients, an anomaly discovered in equal ratios (around 27.50%) in the two sexes and especially on the patients' right palm; **total suppression of line C (Co)** in an average ratio of 15,93%, present more frequently in men than in women, and on the left hand of both sexes; **the much more reduced a-b distance**, more frequently observed in women and especially on the left palm (mainly when referring to the masculine series (20.0% versus 6% on the right palm);

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Table 1. Percent distribution, according to hand and sex, of the palmary anomalies - comparative data

Palmary anomalies	Malady + reference sample	Masculine series			Feminine series			Total		
		L	R	L+R	L	R	L+R	L	R	L+R
A ^R in Hp	T2DM	-	10.00	5.00	3.85	5.40	4.61	2.63	6.84	4.74
	T1DM	-	6.90	3.50	4.10	10.70	7.30	2.25	9.02	5.64
	Reference sample	-	1.00	0.50	-	1.00	0.50	-	1.00	0.50
L ^U in Hp	T2DM	11.66	13.33	12.50	10.00	12.31	11.15	10.53	12.63	11.58
	T1DM	12.07	13.79	12.93	17.33	10.79	14.00	15.03	12.03	13.53
	Reference sample	1.00	2.00	1.50	3.00	1.00	2.00	2.00	1.50	1.75
tt', tt''t'' etc.	T2DM	25.00	30.00	27.50	17.69	36.92	27.31	20.00	34.74	27.37
	T1DM	27.58	41.38	34.48	29.33	38.66	34.00	28.57	39.84	34.21
	Reference sample	15.00	16.00	15.50	16.00	17.00	16.50	15.50	16.50	15.75
T ₁₁ and T ₁₂	T2DM	25.00	18.33	21.66	30.77	20.00	25.38	28.95	19.47	24.21
	T1DM	29.31	15.52	22.41	36.00	18.66	27.33	33.08	17.29	25.18
	Reference sample	5.00	2.00	3.50	7.00	4.00	5.50	6.00	3.00	4.50
t _o	T2DM	3.33	1.66	2.50	4.61	4.61	4.61	4.21	3.68	3.95
	T1DM	-	-	-	2.66	-	1.33	1.50	-	0.75
	Reference sample	-	-	-	-	-	-	-	-	-
Dense and very dense network in Th/I	T2DM	30.00	30.00	30.00	35.38	30.00	32.62	33.68	30.00	31.84
	T1DM	24.13	27.58	25.86	50.66	48.00	49.33	39.09	39.09	39.09
	Reference sample	3.00	5.00	4.00	5.00	7.00	6.00	4.00	6.00	5.00
a-b<21mm in F and 24 mm in M	T2DM	20.00	6.00	13.33	16.92	16.15	16.54	17.89	13.16	15.53
	T1DM	36.21	44.83	40.51	9.33	18.66	14.00	21.00	30.07	25.56
	Reference sample	11.00	13.00	12.00	9.00	12.00	10.50	10.00	12.50	11.25
Cx	T2DM	41.66	25.00	33.48	43.08	33.07	38.07	42.63	30.53	36.58
	T1DM	41.38	36.21	38.79	37.33	25.33	31.33	39.09	30.07	34.58
	Reference sample	14.00	8.00	11.00	7.00	3.00	5.00	10.50	5.50	8.00
Co	T2DM	20.00	18.33	19.17	13.08	12.30	12.69	16.54	15.31	15.93
	T1DM	12.07	8.62	10.34	10.68	4.00	7.33	11.28	6.01	8.65
	Reference sample	3.00	2.00	2.50	5.00	2.00	3.50	4.00	2.00	3.00
Transverse palmary sulcus	T2DM	16.66	10.00	13.33	20.00	8.46	14.23	18.95	9.00	13.95
	T1DM	13.79	12.07	12.93	14.66	9.33	12.00	14.28	10.52	12.40
	Reference sample	3.00	1.00	2.00	1.00	1.00	1.00	2.00	1.00	1.50

T2DM = Diabetes Mellitus type 2 - 190 subjects of which 60 M and 130 F

T1DM = Diabetes Mellitus type 1 - 133 subjects of which 58 M and 75 F (Ana Țarcă 2005)

Reference sample - 200 subjects of which 100 M and 100 F (Ana Țarcă 1995)

the transverse palmary sulcus, or the Simian line, an atavistic formation which - quite unexpectedly - is more frequent in women, prioritarly on the left palm, as also in the case of other maladies, attaining 13.95% (2, 9, 13, 15); **the ulnar loop in Hypothenar (L^u)** occurring only slightly more frequently in men, comparatively to women (*i.e.*, 12.50% and 11.15% respectively), and slightly more on the left hand (table 1); **the radial arch of Hypothenar (A^R)**, prevailing on the right palm of the patients, with quite close ratios in both sexes and finally; **the absence from the palm of triradius $t(t_0)$** a distortion occurring in almost double frequencies in women, comparatively with men (4.61% and 2.50% respectively), being slightly more frequent on the left palm of the affected ones (4.21% versus 3.68% on the right palm). Table 1 also shows that the ten malformative sketches noticed in T2DM have been found, as well, in the patients suffering from insulin-dependent diabetes, some of them even in close ratios (A^R , L^u , $T_{11} + T_{12}$, Cx, transverse palmary sulcus) (16, 17).

The first three and the last two positions in the hierarchization - in decreasing order - of the frequency of the anomalies described are almost similar in the two forms of diabetes (T2DM, T1DM) (table 1). From the other 5 distortions, it is only the palmary sulcus to hold one and the same position (the seventh) in the succession formula of its frequency in

T2DM and T1DM. The same table shows that the two forms of diabetes manifest similar tendencies to both sexes and the bilateral distribution of the 10 anomalies, which suggests the possible utilization of such anomalies as „markers” in a precocious tracing of both T1DM and T2DM of the disease screening in population.

The manner in which the 10 anomalies occur in their carriers, on either one or on both palms simultaneously, which actually indirectly illustrates the patients' extent of affection from a dermatoglyphic perspective, is suggestively presented in Table 2. Thus, most of the ten palmary distortions, *i.e.*, $T_{11} + T_{12}$, t_0 , a-b, Cx, Co and transverse palmary sulcus record highest frequencies for their exclusive disposition on the patients' left palm; A^R , L^u , tt'tt't' for their presence only on the right palm (although, in both cases, the bilateral disposition is numerically well-represented), while the dense and very dense network of the ridges from Th/I, have simultaneous disposition on both palms (59.21%). The quite high frequencies recorded for the bilateral disposition of the 10 distortions, to which one should add the ones for the priority presence on one or another of the two hands, suggest the ample pathological charge of the dermatoglyphic image of the T2DM - affected ones' palm, which should be correlated with the multiple secondary affections present in the clinical picture, as generated by this malady.

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Table 2. Disposition - in the carriers - of the palmary anomalies in T2DM versus T1DM

Palmary anomalies	Affected people	Only on the left palm	Only on the right palm	On both palms	Total carriers
A ^R in Hp	T2DM	6.66	73.33	20.00	7.89
	T1DM	7.69	76.92	15.38	9.77
L ^U in Hp	T2DM	31.43	42.86	25.71	18.42
	T1DM	44.83	31.03	24.13	21.80
tt't''; tt't''t'', etc.	T2DM	19.51	53.66	26.83	43.16
	T1DM	14.51	38.71	46.77	46.61
T ₁₁ + T ₁₂	T2DM	46.37	20.29	33.33	36.31
	T1DM	58.18	20.00	21.82	41.35
t _o	T2DM	41.66	33.33	25.00	6.31
	T1DM	100.00	-	-	1.50
Dense and very dense network in Th/I	T2DM	25.00	15.79	59.21	40.00
	T1DM	17.46	17.46	65.08	47.37
a-b < 21 mm in F and 24 mm in M	T2DM	41.86	20.93	37.20	22.63
	T1DM	16.66	41.66	41.66	36.09
Cx	T2DM	48.11	23.58	28.31	55.80
	T1DM	39.39	21.21	39.39	49.62
Co	T2DM	34.88	32.56	32.56	22.63
	T1DM	52.94	11.76	35.29	12.78
Transverse palmary sulcus	T2DM	36.11	27.77	36.11	18.95
	T1DM	46.15	26.92	26.92	19.55

As in the case of other European sample groups of diabetics suffering from T2DM, investigated by Knussman and Chakravantti cited by Loesch – 1983, besides the above described individual distortions, there have been also noticed, at the level of the whole palmary picture and, especially, for the masculine series, *a spectacular diminution of the patterns' frequency in the interdigital space IV*, up to 19.16% versus 48.6% - the value recorded in the men of the reference sample (9). This situation induced *a change in the classical succession of patterns' distribution in the 5 palmary compartments, space*

IV being placed on the 3rd place in the formula III > Hp > **IV** > Th/I > II instead of **IV** > III > Hp > Th/I > II, *a reversion considered as one of the most severe anomalies of the whole series, evidenced, besides us, by other authors in heart congenital malformations and other grave cardio-vascular diseases* (9, 13, 15). One should nevertheless mention the fact that such general distortion at the level of the palm is the only one which differentiates the T2DM from the T1DM patients and which might be consequently employed as a „marker” in distinguishing the two forms of diabetes in populational studies meant

at a timely tracing of the persons at risk, if considering the extremely large occurrence of the malady in the population of Romania.

CONCLUSIONS

Study of the palmary dermatoglyphics of the T2DM - affected patients has evidenced an ample pathological charge of theirs, as noticed by the 10 anomalies, bearing deep clinical significance, present in a number between 3 and 6, in various combinations, in each patient's palm. Thus, at the level of the whole sample, they should attain ratios that differentiate them sensibly from the reference group of Moldova, being, nevertheless, quite close to the values recorded in patients with T1DM.

Similarly with T1DM or with other genetic or severe teratological maladies, sexual dimorphism in the distribution of the ten anomalies is quite weakly expressed, higher ratios being noticed in the affected women, for the following anomalies: $T_{11} + T_{12}$; the dense network from Th/I; reduced a-b distance; t_0 ; Cx and the transverse palmary sulcus, which might also explain a general, more precarious health condition in many of them, in whom diabetes mellitus is accompanied by other affections, generated by itself.

As to *the bilateral differences in the distribution of the described palmary anomalies*, most of them ($T_{11} + T_{12}$; *the dense network from Th/I; much reduced a-b, t_0 , Cx, Co and the transverse palmary sulcus*) are seen as recording higher ratios on the left palm, which is actually recognized as carrying most of the malformative

sketches of any malady. The 3 remaining anomalies (A^R , L^u , $tt't'$), evidenced a higher frequency on the right palm of the patients of both sexes.

Actually, the manner in which the palmary anomalies appear in the carriers, on either one palm or bilaterally, confirmed a preferential tendency for the exclusive presence on the left palm in the case of distortions $T_{11} + T_{12}$, a-b, t_0 , Cx, Co and the transverse palmary sulcus, followed by the occurrence, exclusively on the right palm, of anomalies A^R , L^u , $tt't'$, while the highest weight for the simultaneous occurrence on both palms was held by the dense and very dense network of the ridges from Th/I. Apart from the 10 individual anomalies signaled out at the level of the palmary compartments in the sample of T2DM diabetics, there have been also evidenced, *an important and severe anomaly of general nature, registered in other European groups affected by the same malady, as well, which assumes a sensible reduction of the pattern frequency in the interdigital space IV* (in men, preponderantly). This led to another important general distortion, namely *situation of the interdigital space IV on the third, instead of the first, position, in the classical formula of succession for patterns' frequency*: III > Hp > IV > Th/I > II instead of IV > III > Hp > Th/I > II, both anomalies being therefore utilized as differentiation indices between T2DM and T1DM in population studies on diabetes.

To conclude with, the results of the present study, most of them agreeing

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fully with the literature in the field, ***even if they are the first to be recorded, at national level, for T2DM, considered from a dermatoglyphic perspective***, might be further employed as reference data for the study of Romanian populations with risk of diabetes. While the distortions might be „markers” in the precocious individual diagnosis of the malady, the dermatoglyphic test, besides the usual clinical, genetic, biochemical, etc., methods, represents procedure for tracing diabetes in the Romanian population.

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