Acta Scientiarum

http://periodicos.uem.br/ojs
ISSN on-line: 1807-8648
Doi: 10.4025/actascihealthsci.v45i1.61110

CIÊNCIAS DA SAÚDE / HEALTH SCIENCES

Fingerprint Patterns in Women with Type 2 Diabetes Mellitus: Computerized Dermatoglyphic Analysis

Fabiane Pertille[1], Adriano Alberti[2*], Josiane Aparecida de Jesus[1], Bruna Becker da Silva[2], Renan Sousa[3], Guilherme Rosa de Abreu[4] Clarissa Martinelli Comim[5] and Rudy José Nodari Junior[6]

[1]Universidade do Estado de Santa Catarina, Chapecó, Santa Catarina, Brazil. [2]Programa de Pós-Graduação em Ciências da Saúde, Universidade do Sul de Santa Catarina, Avenida Pedra Branca, 25, 88137-270, Palhoça, Santa Catarina, Brazil. [3]Universidade do Oeste de Santa Catarina, Joaçaba, Santa Catarina, Brazil. [4]Departamento de Educação Física e Esportes, Universidade Federal Rural do Rio de Janeiro, Seropédica, Rio de Janeiro, Brazil. [5]Universidade do Sul de Santa Catarina, Palhoça, Santa Catarina, Brazil. [6]Salus Dermatoglifia, Joaçaba, Santa Catarina, Brazil. *Author for correspondence. E-mail: adrianoalberti90@hotmail.com

ABSTRACT. Dermatoglyphics can be used as a supporting tool in the early detection of type 2 Diabetes Mellitus in women. The present study aims to investigate the fingerprints of women with type 2 diabetes mellitus through the dermatoglyphic method, and to compare them with women without the disease. It was conducted by obtaining the fingerprints of all 10 fingers of 268 women – which is known as the dermatoglyphic method –, using the Dermatoglyphic Reader®, with data processed in SPSS (IBM SPSS), version 20.0, and a significance level of $p< 0.05$. The researched groups are homogeneous for the age, weight and height variables. The group of women with diabetes had a higher average number of lines on the left thumb, as well as the highest total number of lines on the left hand. Moreover, they had a greater number of deltas, in addition to presenting the whorl shape on fingers 1 to 5 of the left hand, and 1 to 4 of the right hand. We concluded that women with type 2 diabetes had a mark of observation concerning their biological individuality on their fingerprints that differs from that of women without the disease.

Keywords: dermatoglyphics; type 2 diabetes mellitus; Illness.

Received on October 3, 2021.
Accepted on May 13 2022.

Introduction

The epidemiological transition evidences changes in the pattern of illness processes and population mortality when one observes the transformation from a pattern in which infectious and parasitic diseases have caused high mortality rates, to a pattern in which degenerative diseases have become the greatest cause of mortality in the population. (Tavares, Lovate, & Andrade 2018).

Chronic non-communicable diseases (NCDs) represent one of the biggest public health problems today (Brasil, 2017), as they pose challenges due to their difficult identification and management. They are understood as cardiovascular diseases, cancer, chronic respiratory diseases and diabetes (World Health Organization [WHO], 2013).

Diabetes Mellitus (DM), which we address in this research work, refers to a metabolic disorder of heterogeneous etiology, characterized by constant hyperglycemia and disturbances in the metabolism of carbohydrates, proteins and fats. It results in defects in insulin secretion and/or action (Brasil, 2013a).

Type 2 DM (DM2) is the most common form of diabetes, accounting for about 90% of all cases of the disease. Its rates place it among the five most important diseases, when it comes to the burden of illnesses in the country Costa et al.(2017), Shah et al. (2015), and Cardoso and Salles(2008). It presents itself as a public health problem due to its epidemiological growth projection and it might affect up to 700 million people by 2045 (International Diabetes Federation [IDF], 2019).

The disease, as a polygenic disorder, develops from the interaction between environmental factors and multiple genes spread across the genome. How these genes interact with each other and with the environment to produce DM2 is still poorly understood. Unlike DM1, in which genetic risk is mainly concentrated in the HLA area, the genetic component of DM2 risk is not concentrated in just one area, but seems to be the result of the interaction of multiple genes spread across the genome (Ali, 2013). In addition, about fifty genes would be involved in the pathogenesis of DM2, modulating the biochemical and regulatory metabolism, besides the signaling pathways that regulate DNA transcription (Kaput & Dawson, 2007).

In this context, it is important to say that strategies for investigating, identifying and monitoring NCDs are therefore opportune, given the high incidence rate of these diseases. A research possibility in the health field that has been gaining prominence is dermatoglyphics, as it aims to contribute to the identification of DM2 and presents itself as a scientific method that observes fingerprints as a mark of observation referring to biological individuality. Moreover, dermatoglyphics may be able to identify a pattern or a rare mark for diseases (Nodari Junior, 2015; Alberti, Traebert, Traebert, Nodari Junior, & Comim, 2021).

Fingerprints are formed between the twelfth and fourteenth weeks of fetal life and link genetic inheritance with the intrauterine environment provided by the mother Nanakorn, Poosankam, and MongconthawornchaI (2008), Verma and Puri (2015) and Nodari Junior and Fin (2016). From a verification by the dermatoglyphic method, considering fingerprints, it is possible to analyze the quantitative characteristics (a type of shape), the qualitative characteristics (number of lines on the fingers), the essential complexity of the shapes, and the total number of lines (Abramova, Nikitina, & Ozolin, 1995). The shapes found on fingerprints can be classified in accordance with their own variations, as shown in Figure 1.

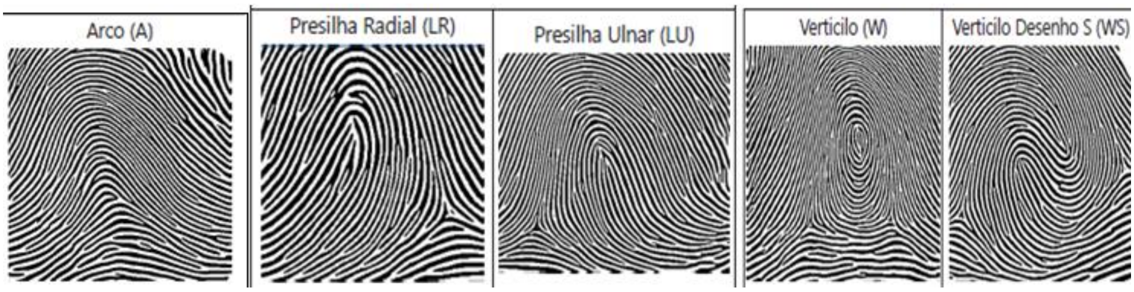

Figure 1. Shapes found by dermatoglyphics.
Source: Nodari Junior and Fin (2016).

The arch (A) shape is characterized by the absence of deltas; it is composed of ridges that cross the phalanx transversely, while the loop (L) has a core and a delta with a loop-like shape, where the skin ridges begin from one end of the finger, curving distally in relation to the other. These loops can be classified into radial loop (LR) and ulnar loop (LU), depending on which side the delta faces. The whorl shape (W) has two deltas and a core where the center lines are concentrated around the core of the shape. The whorl S shape is formed by the baseline, the marginal line and the core line, in a way that allows the construction of two deltas and two cores, with the core being shaped like the letter S (Nodari Junior, 2015).

Once the association between a permanent fingerprint characteristic and diabetes is confirmed, fingerprints could be used for any age to improve the prediction of diabetes before its clinical diagnosis, as dermatoglyphic patterns are genetically determined and can be used as a support for the diagnosis of various hereditary diseases and disorders, including type 2 diabetes (Kakkeri, Attar, & Khan, 2018).

This study aims to investigate the characteristics of the fingerprints of women with type 2 diabetes mellitus by means of the dermatoglyphic method, comparing them with women without this diagnosis.

Material and method

This study is defined as a non-experimental cross-sectional one, with a quantitative approach, based on population, as well as on descriptive and analytical characteristics (Politand Beck, 2011; Creswell, 2010).

Its population consisted of female participants aged 18 years or older, who were recruited into specific groups. The groups were divided into two – a group of women with DM2, with 134 participants, and a control group, composed of non-diabetic women, with 134 participants, totaling a sample of 268 participants.

The collections were carried out from November 2018 to September 2019, and the group of women with DM2 was composed of participants registered in and served by the System for Registration and Monitoring of Hypertensive and Diabetic Patients [*Sistema de Cadastro e Acompanhamento de Hipertensos e Diabéticos*] (Hiperdia) of the Family Health Strategies [*Estratégias de Saúde da Família*] (ESFs) in the municipalities of Chapecó, Joaçaba, Herval D'Oeste and Concórdia, in the state of Santa Catarina, Brazil. Additionally, it involved participants from other institutions and companies, such as the "Best Age University" [*Universidade da melhor idade*] and the "Chapecó Association of Diabetic and Hypertensive Individuals" [*Associação dos Diabéticos e Hipertensos de Chapecó*]. The control group consisted of participants who were recruited while in the ESF waiting rooms, or who frequented the other collection spaces.

The inclusion criteria to compose the group of diabetic patients were: women with DM2 aged 18 years or older, who had a clinical and/or laboratory diagnosis of the disease expressed in their medical records, who were using oral hypoglycemic medications and who had their dermatoglyphs and anthropometric data collected. The exclusion groups comprised diabetic women undergoing insulin therapy, and anomalous, invalid or non-existent fingerprints.

For the control group, the inclusion criteria were: non-diabetic women with a blood glucose test lower than or equal to 200 $mgdL^{-1}$; negative family history, concerning their parents, for diabetes mellitus, and patient's negative self-declaration as to the diagnosis of the disease. As for exclusion, women with anomalous, invalid or non-existent fingerprints were identified.

The protocol chosen to analyze fetal development through the collection of fingerprints was Dermatoglyphics, proposed by Cummins and Midlo (1961), using the Dermatoglyphic Reader® validated by Nodari Junior, Heberle, Ferreira-Emygdio, and Irany-Knackfuss (2008).

For the capture, processing and analysis of fingerprints using the Dermatoglyphic Method, a computerized dermatoglyphic reading process was used, that is, a reader composed of a rolling optical scanner that collects the image, interprets it and transforms it into binary code. Then, a drawing is captured by specific software for processing and reconstruction of real and binary images in black and white.

Anthropometric data on body mass and height were collected using a scale and stadiometer, and race data were obtained through the participant's self-declaration. To collect data from the control group regarding HGT, the G-TECH Free Lite™ glucose meter was used with the respective strips.

Data were collected from the group of diabetic patients, and initially, contact was made with the collection fields (the ESF was chosen for keeping the Hiperdia groups active). Then, the medical records of diabetic women registered in Hiperdia were consulted for the diagnosis of DM2 with a view to meeting the inclusion criteria and organizing a list of possible participants. For logistical purposes, a schedule was prepared with the dates, locations and times for the Hiperdia meetings, in accordance with the ESF's schedule.

The participants in those meetings were instructed about the research and invited to join it. Those who expressed agreement had their data collected after signing the free and informed consent form.

At the time of collection, the subject placed their phalanx (ulna side) on the Dermatoglyphic Reader scanner, rolling it, on its longitudinal axis, to the lateral side (radius) (Nodari Junior, 2015), from the left little finger to the left thumb, then from the right thumb to the right little finger (Nodari Junior et al., 2008).

The data collection for the control group was performed with women who were in the ESF waiting room, who frequented spaces such as the city of the elderly [*cidade do idoso*] and the "Best Age University"; the participants were approached through oral invitation by the researcher. The HGT collection was performed after the dermatoglyphic data were collected, as a way to prevent the exposure of biological material on the scanner of the reader, as well as a possible contamination among the participants. If the HGT result did not meet the inclusion criteria, the patient's medical record, and dermatoglyphic and anthropometric data would be excluded.

The data were subjected to statistical treatment by the Statistical Package for the Social Science (IBM SPSS), version 20.0, which enables the conduction of descriptive and analytical statistics, with a significance level of $p<0.05$ being set. To check normality distribution, the Kolmogorov-Smirnov test was used; normal data distribution was found for variables such as height, age and total number of lines on the left hand (SDTLE) using Student's t test. For the other study variables, a non-abnormal data distribution was observed using the Mann-Whitney test.

To compare the categorical variables (types of shapes), the Chi-Squared test was used. Considering the significant difference among the values expressed by the Chi-squared groups, the recommendation was to perform the Adjusted Residual Analysis (Pereira, 2001). In this case, pieces of data were compared with each other, based on a default value of 1.96.

The research was approved by the Research Ethics Committee under legal opinion No. 2.919.084, on September 30, 2018.

Results

Comparing the group of women who had diabetes with the control group when it comes to their age, weight and height variables, no significant difference was found between them, which shows that they are homogeneous groups in terms of said variables, as shown in Table 1.

Table 1. Mean and standard deviation of the researched groups concerning their age, weight and height variables.

	Group	n	Mean/Standard deviation	p
	DG	134	59.02±11.51	0.763
Age (years)	CG	134	59.25±11.67	
	DG	134	71.49±11.07	0.887
Weight (Kg)	CG	134	71.29±12.07	
	DG	134	1.59±.074	0.654
Height (m)	CG	134	1.60±.061	

Source: the authors

As for ethnicity, in the group with diabetes, 74.6% of the participants declared themselves to be white, followed by 22.4, 2.2 and only 0.7% of subjects identifying themselves as brown, black and yellow, respectively. In the control group, 89.2% considered themselves white, 8.2%, brown, and 2.2%, black.

With respect to the application of the dermatoglyphic method, regarding the qualitative analyses, it is possible to state that the analysis of the lines is a specific numerical variable of dermatoglyphics that helps assess a population with a certain characteristic and/or disease. The analysis involving the continuous variables (total number of lines per finger, per hand, and on both hands) revealed a significant difference between the groups. The group with diabetes had a greater average number of lines on the left hand – total sum of lines on finger 1 (MESQL1) and total sum of lines on the left hand (SQLTE), in addition to a higher number of deltas, as shown in Table 2.

Table 2. Mean and standard deviation for number of lines on the fingerprints of the left and right hands, comparing DG and CG.

	DG	CG	p
MESQL1	13±6	11±6	0.006*
MESQL2	9±6	8±6	0.178
MESQL3	10±6	9±7	0.134
MESQL4	14±6	12±7	0.056
MESQL5	11±6	11±6	0.845
SQTLE	56±25	50±25	0.045*
MDSQL1	14±6	13±6	0.318
MDSQL2	10±7	9±7	0.109
MDSQL3	10±6	10±6	0.635
MDSQL4	13±7	12±7	0.107
MDSQL5	11±6	10±6	0.240
SQTLD	58±26	53±24	0.104
SQTL	15±49	04±48	0.075
D10	12±4	11±4	0.029*

*Significance level p<0.05.Legend: MESQL1 Left hand, total number of lines on finger 1- thumb; MESQL2 Left hand, total number of lines on finger 2- index finger; MESQL3 Left hand, total number of lines on finger 3- middle finger; MESQL3 Left hand, total number of lines on finger 4- ring finger; MESQL5 Left hand, total number of lines on finger 5- little finger; MDSQL1 Right hand, total number of lines on finger 1- thumb; MDSQL2 Right hand, total number of lines on finger 2- index finger; MDSQL3 Right hand, total number of lines on finger 3- middle finger; MDSQL4 Right hand, total number of lines on finger 4- ring finger; MDSQL5 Right hand, total number of lines on finger 5- little finger. Source: the authors.

To compare the categorical variables (types of shape), the Chi-Squared test was used, which detected a significant difference between the two groups, for all fingers. Due to this significant difference, the recommendation by Pereira (2001) was followed, that of conducting an adjusted residual (AR) analysis, as shown in Table 3.

Table 3. p value for right and left fingers.

	MET1	MET2	MET3	MET4	MET5	MDT1	MDT2	MDT3	MDT4	MDT5
p	0.001*	0.000*	0.002*	0.000*	0.015*	0.004*	0.000*	0.002*	0.000*	0.002*

*Significance level p<0.05.MET1 Shape on left hand, finger 1; MET2 Shape on left hand, finger 2; MET3 Shape on left hand, finger 3; MET4 Shape on left hand, finger 4; MET5 Shape on left hand, finger 5; MDT1 Shape on right hand, finger 1; MDT2 Shape on right hand, finger 2; MDT3 Shape on right hand, finger 3; MDT4 Shape on right hand, finger 4; MDT5 Shape on right hand, finger 5. Source: the authors.

From the data shown, a significant result can be observed in the group with diabetes, for the W figure, on fingers MET1, MET2, MET3, MET4, MET5, MDT1, MDT2, MDT3 and MDT4, and for the LU figure on finger MDT5. It was possible to verify that, for the CG, the WS value was significant on fingers MET2, MET4, MDT2, MDT3, MDT4 and MDT5, and the A figure for fingers MET1 e MET3. On MET5 and MDT1, although there was a significant difference, the adjusted residual analysis did not reveal any value that characterized the control group as to these fingers, as shown in Table 4.

Table 4. Types of fingerprint figures on the left and right fingers, comparing the diabetic group and the control group.

		Number of fingerprints				
		UMA	LU	LR	W	WS
		AR	*AR*	*AR*	*AR*	*AR*
MET1	Diabetic patients	-2.1	-0.1	-0.7	3.9	-0.5
	Control group	2.1	0.1	0.7	-3.9	0.5
MET2	Diabetic patients	-1.8	0.0	-0.5	5.6	-2.7
	Control group	1.8	0.0	0.5	-5.6	2.7
MET3	Diabetic patients	-2.7	1.0	0.2	3.1	-1.3
	Control group	2.7	-1.0	-0.2	-3.1	1.3
MET4	Diabetic patients	-1.3	0.3	-1.0	5.5	-4.0
	Control group	1.3	-0.3	1.0	-5.5	4,0
MET5	Diabetic patients	-1.6	0.6	0.5	2.8	-1.6
	Control group	1.6	-0.6	-0.5	-2.8	1.6
MDT1	Diabetic patients	-0.2	-0.4	0.4	3.7	-1.8
	Control group	0.2	0.4	-0.4	-3.7	1.8
MDT2	Diabetic patients	-1.6	-0.3	0.9	5.0	-3.0
	Control group	1.6	0.3	-0.9	-5.0	3.0
MDT3	Diabetic patients	-1.1	0.3	0.0	3.5	-2.1
	Control group	1.1	-0.3	0.0	-3.5	2.1
MDT4	Diabetic patients	-1.1	-0.2	1.2	5.7	-4.9
	Control group	1.1	0.2	-1.2	-5.7	4.9
MDT5	Diabetic patients	-1.5	2.2	0.0	1.7	-3.5
	Control group	1.5	-2.2	0.0	-1.7	3.5

Source: the author

Discussion

The incidence of DM in women is increasing in the Brazilian population. According to the VIGITEL historical series, the proportion of DM in women was 6% in 2011, rose to 9.9% in 2016, and stood at 8.1% in 2019 (Brasil, 2012; 2016; 2019).

The presence of the disease has become more common in older women and increased after the age of 45. The target audience for DM screening, recommended by the American Diabetes Association, suggests, among other aspects, an age of 45 years or older (Brasil, 2013b). The findings of the present study reinforce these data, since the studied population was composed only of women, and the group with diabetes had a mean and standard deviation for age of 59.02 ± 11.51, when considering the age group affected by the disease.

The research revealed that the group with diabetes had a higher average number of lines compared to the control group for MESQL1 and SQTLE, which is a significant result for women with DM2. Another significant finding of this research revealed the presence of a greater number of deltas on all 10 fingers (D10) in the group with diabetes, compared to the control group.

These findings are innovative for dermatoglyphic analysis in women with DM2, as it was not possible to find other studies in the literature that assessed this variable so far. The computerized collection method enables an individual assessment of all fingers of both hands, proving that this is an opportune moment to analyze numerical variables, which allows for precision in the use of dermatoglyphics for DM2 in women.

The analysis of this research was concerned with identifying the type of shape found on all right and left fingers, considering five classifications for the type of the shape (A, LU, LR, W and WS). In addition, we analyzed any differentiation between the diabetes group (GD) and the control group (CG) in the female population, using the computerized data collection method.

A study with a mixed sample of men and women, with 100 women included in the sample (50 with diabetes and 50 in the control group), revealed that women with diabetes had, on both hands, a predominant W, followed by L and A, while the L, W and A shapes were found in the control group (Kakkeri et al., 2018).

The results of the study described above, when compared with the findings of the present research, reveal a similarity in the group of women with diabetes regarding the predominant W shape. However, they differ as to the figure found in the control group, which can be understood because that study did not specify the WS, LU and LR figures, in addition to having presented the figure(s) with greater frequency by finger, which was done by the study we conducted, since this piece of data was categorized. The collection method also presents itself as a strength, since this research used a computerized collection method, unlike the aforementioned one, which used ink and paper.

Another study on DM2 in a mixed group of men and women, composed of 40 women with diabetes and 40 women as a control group, revealed that both groups had a predominance of the L, W and A shapes on the right and left hands. A significant difference in the pattern of L and W, both on D-IV, was also noticed in the group with diabetes (Nayak, Patel, & Pensi, 2015).

That study, when compared to the findings of the present research, reveals a difference regarding the collection method (ink and paper versus computerized system), in addition to the studied shapes, when considering only three classifications (A, L and W), while the present investigation used five-digit patterns (A, LU, LR, W and WS). The fingers of both hands had their shapes analyzed, but all received the same nomenclature, so it was not possible to identify separately the predominance of shapes by the fingers of the right and left hands. Another detail to be mentioned is that the aforementioned study had its participants separated by sex, since the study researched a mixed population. Consequently, it does not allow for a comparison of results with the findings of our current research, which was concerned with analyzing the type of shape by finger and hand only in women.

Analyzing the dermatoglyphic data of 50 women with diabetes and 50 women in the control group (Mehta & Mehta, 2015), it was possible to observe that, on the right and left hands of the group with DM2, the most frequent figures were W, L and A. However, figure A was not significant for the group. On the right and left hands of the control group, the most frequent shapes were L, W and A. Thus, in the study, there is no association between the type of shape by the fingers of each hand, and the studied shapes are only A, L and W. Those findings differ compared to the results of this research, as caution was taken when analyzing the shapes by the fingers of each hand, without quantifying the shapes by hands. Other aspects that differ from those of the present study are the types of researched shapes, the collection method and the sample size.

The W shape was also predominant in a study with 13 women who had DM2, followed by LU, A and LR, while the control group, composed of 26 women without diabetes, had the LU shape, followed by W, LR and A, respectively (Marpaung & Jaya 2015). The results for the group of women with diabetes corroborate the research findings regarding the W shape, but when it comes to the control group, the LU findings are different from those of the research findings (WS). The study did not consider the WS shape in its analysis, which, in this research, presents itself as the predominant shape in the control group.

Analyzing the shapes by the fingers of each hand, the aforementioned study presented its results by the researched groups. However, it did not specify the findings by the gender of the participants, since it had a mixed population. The findings of that study differ from the results of our current research, in both studied groups, since they presented the W shape as predominant, while in the control group the WS shape predominated, respectively. These differences can be explained by the sample size used in the research (134 women), by the use of a computerized method, which guarantees greater reliability for the assessment of variables, together with the use of the classification of the shapes into five subtypes.

That study in a mixed population of men and women was composed of a total of 50 women with DM2 and 50 women without diabetes as a control group. Assessing the A, LU, LR and W figures in a mixed population, it was verified that both groups had a prominence of LU, W, A and LR, but there was no significant difference among the figures by hand from group to group (Ojha & Gupta, 2014).

The findings of the study mentioned above, when compared to the findings of our research, have differences as to the methodological approach, in terms of sample size and homogeneity, and the method used for data collection and presentation. That study analyzed four types of shapes (A, LU, LR and W), while our research added the WS shape. Another fact to be mentioned is that, in the aforementioned study, there is no discrimination of shapes by the finger of each hand, while our investigation assesses the shapes by specific fingers of each hand, revealing a dermatoglyphic mark for women with diabetes.

That study was conducted with 37 women that had DM2 and compared with 37 other women without diabetes (Srivastava & Rajasekar, 2014) and revealed that the group with diabetes (DG) had the W, LU, A and LR figures, while the control group (CG) had LU, W, A and LR.These findings, when compared to the results of our research, are similar as to the type of predominant shape in the group with diabetes (W), but are in disagreement with the figure in the control group (LU), since this investigation found WS which can be explained by the fact that said study has not investigated the WS shape in the studied population.

The limitations of the study can be expressed by the fact that it was conducted regionally, which directly implies variables such as ethnicity. For this reason, we mention here the need to carry out complementary studies with a larger population and/or in other regions of the country.

Researching type 2 diabetes using the dermatoglyphic method allows for the improvement of methods and processes. We defend that this can be done in an interdisciplinary way in order to promote the national improvement of the health system. The reason is that there is the possibility of recognizing an anatomical structure and assigning it a functionality that, based on studies and research, can be used in the clinical practice of professionals as a collaborative way of screening for the diagnosis of type 2 diabetes mellitus.

From the findings of this research, it is suggested that further studies be conducted in the female population to improve the results, and that this methodology be used in the public health system, as possible potentialities about the diagnosis of DM2 can be identified. With this in mind, actions in the field of prevention and early diagnosis of diseases can be broadened, due to the high incidence rate of the disease. With future epidemiological projection, the method we used can serve as an alert for new cases of the disease.

Conclusion

The data of the present study showed, through the dermatoglyphic method, using the Dermatoglyphic Reader®, that women with DM2 have on their fingerprints a mark of observation of biological individuality that differs from that of women without DM2. This fact suggests an additional way of tracking the disease, even at earlier ages, to facilitate its prevention, in addition to revealing that the fingerprint characteristics of women with DM2 are present. The process revealed aspects in terms of continuous variables, with a higher average number of lines and deltas; for categorical variables, the whorl appears as significant in the group with diabetes when compared to the control group, which presented a lower average number of lines, and the whorl (S) shape is significant.

References

Alberti, A.,Traebert, J., Traebert, E., Nodari Junior, R.J., & Comim, C. M. (2021). Association between gestational period and obesity in children with the use of dermatoglyphic traits: A preliminary study. *PLoS ONE*, *16*(9), 1-15.

Abramova, T., Nikitina, T., & Ozolin, N. (1995). De l'utilisation des dermatoglyphes digitaux dans la selection des sportifs. *Teor Prak Fiz Kult*, *3*, 10-15.

Ali, O. (2013). Genetics of type 2 diabetes. *Mundial Journal of Diabetes*, *4*(4), 114-123. Retrieved from http://www.wjgnet.com/1948-9358/full/v4/i4/114.htm.

Brasil. Ministério da Saúde, Secretaria de Vigilância em Saúde. (2012). *Vigitel Brasil 2011: Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico*. Brasília, DF: Ministério da Saúde.

Brasil. Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica. (2013a). *Diretrizes para o cuidado das pessoas com doenças crônicas nas redes de atenção à saúde e nas linhas de cuidado prioritário*. Brasília, DF: Ministério da Saúde.

Brasil. Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica. (2013b). *Estratégias para o cuidado da pessoa com doença crônica: diabetes mellitus* (Cadernos de Atenção Básica, n. 36). Brasília, DF: Ministério da Saúde.

Brasil. Ministério da Saúde, Secretaria de Vigilância em Saúde, Departamento de Vigilância de Doenças e Agravos Não Transmissíveis e Promoção da Saúde. (2017). *Vigitel Brasil 2016: Vigilância de fatores de risco e proteção crônica para doenças por inquéritos brasileiros: proteção crônica de fatores de risco e distribuição sociográficas nas capitais dos 26 estados e no Distrito Federal*. Brasília, DF: Ministério da Saúde.

Brasil. Ministério da Saúde, Secretaria de Vigilância em Saúde, Departamento de Análise em Saúde e Vigilância de Doenças Não Transmissíveis. (2019). *Vigitel Brasil 2018: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico*. Brasília, DF: Ministério da Saúde.

Cardoso, C. R. L., & Salles, G. F. (2008). Gross proteinuria is a strong risk predictor for cardiovascular mortality in Brazilian type 2 diabetic patients. *Brazilian Journal of Medical and Biological Research*, *41*(8), 674-680. Retrieved fromhttps://www.scielo.br/j/bjmbr/a/ZxwPJLtmfWZtyPpTJ7dx55x/?lang=en. DOI: https://doi.org/10.1590/S0100-879X2008005000035

Costa, A. F., Flor, L. S., Campos, M. R., de Oliveira, A. F., Costa, M. F. S., Silva, R. S., ... Schramm, J. M. A.(2017). Carga do diabetes mellitus tipo 2 no Brasil. *Cadernos Saúde Pública*, *33*(2), e00197915. Retrieved fromhttp://www.scielo.br/scielo.php?script=sci_arttext&pid=S0102-311X2017000205011&lng=pt&nrm=iso. DOI: https://doi.org/10.1590/0102-311X00197915

Creswell, J. W. (2010). *Projeto de pesquisa: métodos qualitativos, revisados e mistos* (3a ed., M. Lopes. Trad.). Porto Alegre, RS: Artmed.

Cummins, H. E., & Midlo, C. H. (1961) Finger prints, palms and soles uma introdução à dermatoglifia. Nova York, NY: Dove Publications.

International Diabetes Federation [IDF]. (2019*). Atlas de diabetes* (9a ed.).Retrieved from https://www.diabetesatlas.org/en/.

Kakkeri, S. R.,Attar, H., & Khan, J. (2018). Correlation between fingerprint patterns in type-II diabetes mellitus. *Al Ameen Journal of Medical Sciences*, *11*(3), 161-165.

Kaput, J., & Dawson, K. (2007). Complexity of type 2 diabetes mellitus data sets emerging from nutrigenômica research: A case for dimensionality reduction? Mutation Research, 622(1-2), 19-32. DOI: doi.org/10.1016/j.mrfmmm.2007.02.033

Mehta, A., &Mehta, A. (2015) Study of fingerprint patterns in type II diabetes mellitus. *International Journal of Anatomy and Research*, *3*(2), 1046-1048. DOI: http://dx.doi.org/10.16965/ijar.2015.155.

Marpaung, T. D., & Jaya, T. H. (2015). Hubungan Pola Dermatoglifi dengan Diabetes Mellitus Tipe II di RSUP Dr Mohammad Hoesin. *Jurnal kedokteran dan kesehatan*, *2*(3), 297-304.

Nanakorn, S., Poosankam, P., & MongconthawornchaI, P. (2008). Perspective software de imagem de impressão digital automatizado sem tinta para pesquisa de impressão digital. *Journal of Medical Association of Thailand*, *91*, 82-85.

Nayak, T., Patel, S., & Pensi, C. A. (2015). The study of palmar dermatoglyphics in non-insulin dependent diabetes mellitus patients. *BJ Kines: National Journal of Basic & Applied Sciences*, 7, 55-61.

Nodari Junior, R. J. (2015). Dermatoglifia: Una herramienta para la prescripción del ejercicio en la salud. In J. A. M. Murcia, M.C. S. C. Conceição (Ed.), *Motricidad Humana hacia una vida más saludable* (p. 302). Chile: Universidad Central de Chile.

Nodari Junior, R. J., & Fin, G. (2016). *Dermatoglyphic*: *Fingerprints as a marker gene and embryo development*. Sallus Dermatoglifia.

Nodari Junior, R. J., Heberle, A., Ferreira-Emygdio, R., & Irany-Knackfuss, M. (2008). Impressões digitais para diagnóstico em saúde: validação de protótipo de escaneamento informatizado. *Revista de Salud Pública*, *10*(5).

Ojha, P., & Gupta, G. (2014). Dermatoglyphic study: A comparison in Hands of type II Diabetes Mellitus Patients and normal persons of udaipur region. *Journal of Evolution of Medical and Dental Sciences*,*3*(47), 11358-11368. DOI: 10.14260/jemds/2014/3486.

Pereira, J. C. R. (2001). *Análise de dados qualitativos: estratégias metodológicas para as ciências da saúde, humanas e sociais*. São Paulo, SP: Edusp.

Polit., D. F., & Beck, C. T. (2011). *Fundamentos de pesquisa em enfermagem: avaliação de estudos para a prática da enfermagem* (7a ed.). Porto Alegre, RS: Artmed.

Shah, A. D., Langenberg, C., Rapsomaniki, E., Denaxas, S., Pujades-Rodriguez, M., & Gale, C. P. (2015). Type 2 diabetes and incidence of a wide range of cardiovascular diseases: a cohort study in 1.9 million people. *The Lancet*, *385*(S86). DOI: https://doi.org/10.1016/S0140-6736(15)60401-9.

Srivastava, S., & Rajasekar, S. S. (2014). Comparison of digital and palmar dermatoglyphic patterns in diabetic and non- diabetic individuals IOSR. *Journal of Dental and Medical Sciences*,*13*(7), 93-95. DOI: https://doi.org/10.9790/0853-13739395

Tavares, J., Lovate, T., & Andrade, I. (2018). Transição epidemiológica e causas externas de mortalidade na região sudeste do Brasil. *Revista de Geografia e Ordenamento do Território*, *15*, 453-479. http://dx.doi.org/10.17127/got/2018.15.019

Verma, I. C., & Puri, R. D. (2015). Global burden of genetic disease an the role of genetic scriining. *Seminars in Fetal e Neonatal*, *20*(5), 354-363.

World Health Organization [WHO]. (2013*). Global action plan for the prevention and control of noncommunicable diseases 2013-2020*. Geneva, GE: WHO.Retrieved fromhttp://www.who.int/global-coordination-mechanism/publications/global-action-plan-ncds-eng.pdf