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Original research

Dermatoglyphic biomarkers in mothers whose offspring completed suicide A clue for screening out families at risk?

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***Abstract*:** Background: The term dermatoglyphics literally means skin carving. It is the scientific study of the skin configurations on the volar side of fingers, palms, toes, and soles, and a branch of physical anthropology, medicine, genetics, and psychobiology. Since the 1920s, numerous studies have reported that unusual and irregular dermatoglyphics are associated with specific medical and psychiatric conditions. The current study is in line with studies searching for biological markers related to suicidal behavior, and was initially designed to focus on both parents since skin configurations are hereditary and completed suicide is influenced by genetic factors. Hence, to identify a dermatoglyphic biomarker in these parents means to identify, at a preliminary stage of suicidal risk assessment process, mothers and fathers whose offspring might have a disposition to complete suicide, before they take the first step to kill themselves. Unfortunately, only two fathers volunteered to participate. Methods: Dermatoglyphic prints of fingers and palms were obtained from a sample of bereaved mothers, and compared with the dermatoglyphics of a control group. Results: The results show that the research group is characterized by a distinctive set of uncommon dermatoglyphic features, and thus suggest that dermatoglyphics can contribute to screening out families at risk. Discussion: The research has succeeded in attaining preliminary evidence supporting an association between specific dermatoglyphics and the bereaved mothers. The results warrant replication and refinement in larger samples of bereaved parents of both genders. With further investigation, dermatoglyphic characteristics could lay the groundwork for a non-invasive method of screening out mothers and fathers whose offspring might have a disposition to complete suicide.

Keywords: *dermatoglyphics, biomarkers, completed suicide, families at risk*

Completed suicide poses a crucial professional challenge with regard to prevention: the challenge to identify a particular suicidal person before he/she takes the very first move to kill him-/herself. Unfortunately "the prediction of suicidal behaviour is based on inexact criteria that are relatively poor at predicting the behaviour of a given individual. Predicting suicide at the level of individual patient is not possible at the present time, even among high-risk groups of patients" (Sher, 2004). Nevertheless, indefatigable efforts are made to reduce the number of cases of suicide, and professionals employ three lines of approach to attain this aim. The first one is a universal approach, designed for everyone, but it is employed in a defined population regardless of their risk for suicide, as for example school-based suicide prevention programs (Eckert et al., 2009). The second is a selective approach which is focused on subgroups at increased risk, for example prisoners (Tartaro and Lester, 2009). The third approach is the indicated approach which is designed for individuals who have a risk factor or condition that puts them at a very high risk. For

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example, alcohol abuse is a significant contributing factor to the suicide risk (Gruenwald and Ponicki, 1995). Quite a few researchers have been trying to find biological markers related to suicidal behavior. Since "individuals at risk often do not disclose their suicidal thoughts, the introduction of objective measures -such as biomarkers- of suicide risk might help in predicting which individuals will eventually die by suicide" (Blasco-Fontecilla and Oquendo, 2016). However, regarding suicide, "none of the putative biological markers identified to date are sensitive or precise enough to recommend their routine use in the clinical setting; additional translational and clinical studies are needed to understand the complex brain–mind relationship involved in suicidal behaviors" (Ganz et al., 2010).

Trying to identify biological markers related to suicide was the guiding principle of the current research, which was initially designed to focus on both parents, given that "There is consistent evidence suggesting that genetic factors play an important role in the predisposition to suicide and suicidal behaviors" (Turecki, 2001), and that "Family, twin, and adoption studies have established a genetic basis of suicidal behavior" (Zai et al., 2012).

The reason for focusing on biomarkers in parents is plain and simple: to identify a specific biomarker in these parents means to identify, at a preliminary stage of the risk assessment process, mothers and fathers whose offspring might reveal an inherited disposition to complete suicide.

Since completed suicide is influenced by genetic factors and epidermal patterns in fingers and palms are hereditary, as has been established long ago (Holt, 1968; Mulvihill and Smith, 1969; Verbov, 1970; Reed et al., 1975), I have designed this exploratory study to examine whether parents of offspring who completed suicide are characterized by distinctive skin configurations. In case of positive results further studies could provide a firm basis for the possibility of screening out families at risk through an analysis of parental skin configurations, of parental dermatoglyphics.

What does "dermatoglyphics" mean?

Dermatoglyphics, which literally means skin carving, is the scientific study of the ridges and creases on fingers and palms (toes and soles), and a branch of physical anthropology, medicine and genetics. One of the major scientific contributions was made by the Czech biologist Joannes Evangelista Purkinje in 1823. He was the first to systematically classify the varieties of patterns of the fingers. This important scientific landmark was followed by the publication in 1892 of Francis Galton's "Finger Prints", a volume that dealt with morphology, classification, inheritance and racial variation. During the early part of the twentieth century, Cummins and Midlo (1943/1961) utilized dermatoglyphics in medical research, and in the course of time links between dermatoglyphics and diseases or congenital abnormalities have been explored. For example, in medical disorders such as chromosomal aberrations (Stocker et al, 2001), diabetes (Ziegler et al, 1993) and childhood leukemia (PurvisSmith et al, 1973), and in psychological problems including schizophrenia (Galembo-Smith et al., 2012), bipolar disorder (Shrivastava et al., 2016), hypertension (Floris et al., 1998; Wijerathne et al., 2015) and infantile autism (Tarca and Barabolski, 2003; Stosljevic and Adamovic, 2013; Oron, 2014).

As to completed suicide, except in Russia, no study has been published yet concerning its association with dermatoglyphics. Zoroastrov and colleagues (2009) found that a few foot skin patterns do characterize corpses of male suicide victims, different from patterns found in the control group. On the other hand, Ivanenko and his colleagues (2011) showed that the correlation between selected dermatoglyphic features (on fingers, palms, toes, and soles) and the predisposition to suicide is either insignificant or moderately significant.

As to self-injurious behavior, the results of an exploratory research show that a group of women who injure themselves is characterized by a distinctive set of uncommon dermatoglyphic features (Oron, 2016).

To conclude, epidermal ridges and patterns, which are established by the end of the second trimester of fetal development and remain unchanged over the course of life, are considered as markers of prenatal disturbances (Rife, 1990).

As to the dermatoglyphics of phenotypically healthy parents of probands, studies show that the parents and the probands share several, but not all, of the irregular dermatoglyphic features, which means that differences exist between these parents and healthy controls. It was found, for instance, that mothers and fathers of children with Down Syndrome (Trisomy 21) occupy an intermediate position between their affected children and parents of normal children (De Izuzquiza et al., 1986). A similar result was found in infantile autism (Milicic et al., 2003). In schizophrenia and non-affective psychoses a parent-of-origin effect was noted (Divakaran et al., 2013).

By now, no study has been published yet concerning the association between dermatoglyphics and parents whose offspring completed suicide; the current study is an exploratory search for preliminary indications supporting such an association.

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Method

Participants

The research group was made up of seven mothers whose offspring completed suicide, aged 70 to 84 years, compared to seven women participants in the 66-76 age range. (Since only two fathers volunteered to participate the present research focused exclusively on mothers).

Measures and Procedure

Participation was voluntary. Participants received an explanation of the purpose and procedure of the study and provided informed consent.

Dermatoglyphic prints of fingers and palms of all the participants were obtained and analyzed by the author. Qualitative analysis of the prints employed the classifications in Henry (1900, Part I), Cummins and Midlo (1961, Chaps. 4,5), FBI (1993, Ch. II), Bali (1994, Ch. 9), Park et al (2010). Quantitative analysis employed the method explained by Cummins and Midlo (1961).

Statistical analysis

1- Statistical tests of significance. The chi-square test was used to compare the frequencies of the discrete data, and the T-test to compare the means of the quantitative features. Three levels of significance were predefined: $p \leq 0.1$, 0.05 and 0.01. (The $p \leq 0.1$ level was included since an exploratory research calls for a more liberal attitude concerning the decision criteria).

2- Effect-size measurements. Statistical tests of significance tell us the likelihood that research results differ from chance expectations, but even a statistically significant difference may not be practically important, and vice versa. Effect-size measurements tell us the relative magnitude of the difference between the research and control groups, which are an interpretable description of the size of an effect.

The effect-size of the discrete data was calculated by the odds ratio measurement, and that of the continuing features by Cohen's d.

Results were accepted if they reached either the level of significance or the effect- size threshold or both.

Results

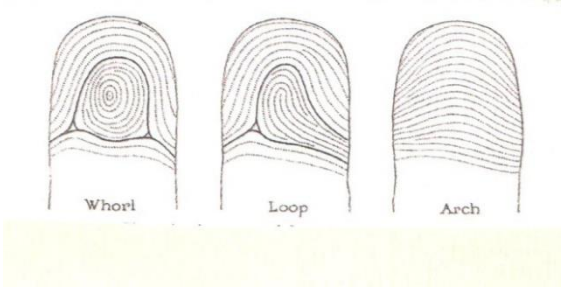
Based on the analysis of the total number of digits and palms, ten dermatoglyphic characteristics were observed which differentiate between the research and the control group - one on finger tips and nine on palms. Seven of these characteristics are more frequent, while three are less frequent in the research group than in the control group.

The common and the uncommon dermatoglyphic characteristics are described in detail, especially for those readers who are not familiar with the study of dermatoglyphics, and numbered consecutively.

Fingers

Figure 1 shows the three basic (or frequent) patterns located on the tips of the fingers (Source: Cummins and Midlo, 1961, p. 56). The ridges on the skin form these patterns. The pattern of the whorl, for example, is made up of circular ridges. In addition the whorl pattern possesses two deltas, one on the lower left side of the pattern and one on the lower right side. A delta indicates a meeting point of three opposing ridge systems that form a Y shape. The loop pattern possesses only one delta, and the arch none.

Figure 1. The three basic patterns on fingers



1. The whorl pattern is less frequent in the research group. Table 1 presents the frequency of this characteristic in percentage, compared with the control group.

Table 1. Comparison of percentage frequency of digital characteristics

Digital characteristics				
Characteristic	**Research group**	**Control group**	**Significance Level**	**OR**
1. Whorl	34.5%	54.3%	$p \leq 0.012$	2.25

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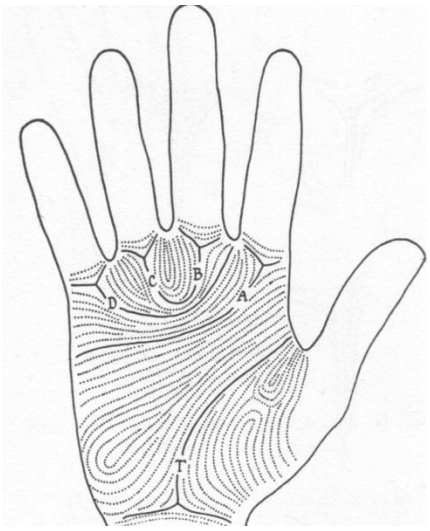
Palms

A human palm is presented in Figure 2 (Source: Cummins and Midlo, 1961, p. 88).

Figure 2. The human palm



There are five deltas (triradii) on a palm: four digital deltas (marked: A, B, C and D) and an axial delta (marked by the letter: T).

As in the finger patterns, a delta indicates a meeting point of three opposing ridge systems that form a Y shape - the bold shape above each letter and beneath the letter T.

On the palms, nine dermatoglyphic characteristics were observed which differentiate between the two groups of participants.

2. Main line of delta C

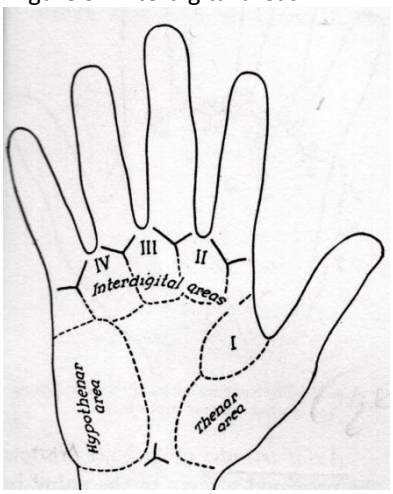
Each delta has a main line, which originates from its proximal radiant (See Figure 2, the bold lines beneath each letter and above the letter T). In the control group the main line of delta C recurves mainly distally, terminating in area III (See Figure 3). By contrast, in the research group this line more frequently terminates in area IV.

3-4. Interdigital configurations

Ridges form configurations. A configuration is defined as a clear arrangement of ridges which separate it from surrounding ridges (for an example, see Figure 2, between the third and the fourth digits). By contrast, a pattern is a more definite form of configuration which is composed of sharply recurved ridges, e.g. a whorl.

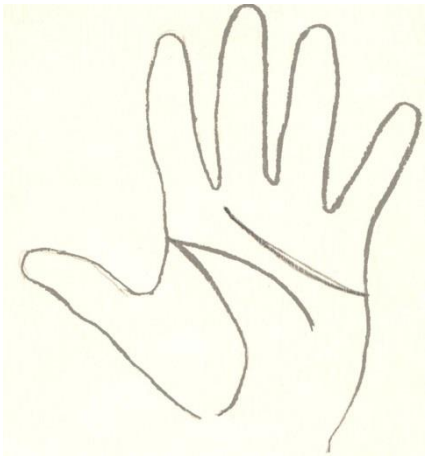
Compared to the control group, the research group's palms are characterized by more configurations in area IV, and by less configurations in area III. (Figure 3, source: Cummins and Midlo, 1961, p.85)

Figure 3. Interdigital areas



On the human palm there are three primary creases which are constant in their locations. Two are transverse creases: the distal crease close to the four fingers, and the proximal one (Figure 4). The third is the radial longitudinal crease, which embraces the area near the thumb.

Figure 4. Three primary creases



5. Separate radial starting points

Usually, the proximal transverse crease and the radial longitudinal crease have a common radial point of origin (see Figure 4). Rarely, each of these creases has a separate starting point on the radial margin of the palm (Figure 5).

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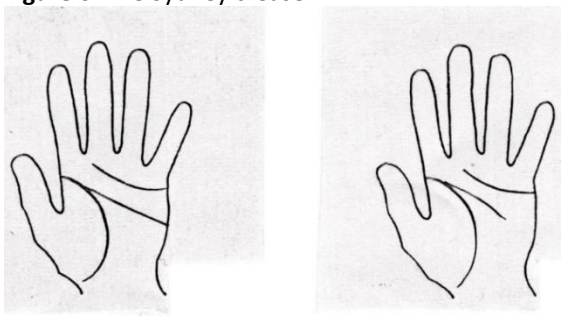
Figure 5. Separate radial starting points

Above 60% of the research group are characterized by this feature as against none in the control group.

6. Sydney Crease

In contrast to its usual form (Figure 6, the right palm), the proximal crease sometimes extends to the ulnar border of the palm in a continuous straight line. This type of line is termed the Sydney Crease (Figure 6, on the left).

Figure 6. The Sydney crease

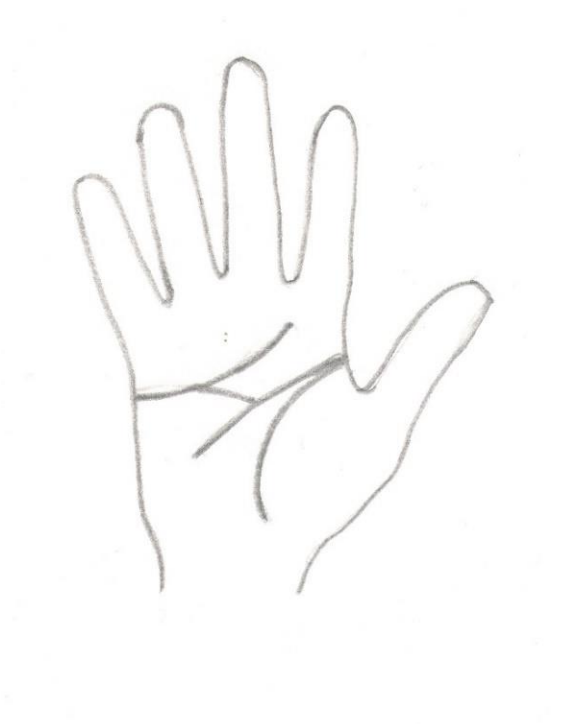


In three cases the mothers' palms show this phenomenon compared to none among the women of the control group.

7. Bridged transverse creases

Rarely, the distal and the proximal creases are connected by a short crease, a bridge-like crease (Figure 7), which is of the same width and depth as the two primary creases.

Figure 7. Bridged transverse creases



Four palms in the research group are characterized by this feature as against none in the women control group.

8. Broken creases

Seldom, the regular and smooth flow of each of the three primary creases (see Figure 4) might be interrupted in one, or more points and then resumed.

Above 40% of the mothers' palms show this characteristic compared to none of the women in the control group.

Table 2 shows the frequency of the seven discrete (qualitative) palm characteristics in percentage, compared with the control group.

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Table 2. Comparison of percentage frequency of palmary characteristics

Palm characteristics				
Characteristic	**Research group**	**Control group**	**Significance Level**	**OR**
2. Main line C (area IV)	75.0%	27.2%	$p \leq 0.11$	2.75
3. Configuration area III	35.7%	64.3%	$p \leq 0.1$	3.24
4. Configuration area IV	42.9%	28.6%	n.s.	1.88
5. Separate radial starting points	64.3%	0.0%	$p \leq 0.0001$	17.15
6. Sydney Crease	21.4%	0.0%	$p \leq 0.03$	8.8
7. Bridged creases	28.6%	0.0%	$p \leq 0.015$	12.4
8. Broken creases	42.9%	0.0%	$p \leq 0.003$	22.1

9-10. Quantitative characteristics – Ridge count

Two quantitative characteristics were observed on palms, which also differentiate between the two groups of participants. Ridge counts were done between deltas A and B and between deltas C and D (see Figure 2).

The mean ridge count between deltas A and B in the research group was lower than that in the control group, and the mean between deltas C and D was higher compared to the control group (See Table 3).

Table 3. Comparison of the mean ridge count (RC) between deltas A-B and C-D

Characteristic	**Research group**	**Control group**	**Significance Level**	**Cohen's d**
9. RC a-b	$\overline{x}$ = 37.58 (std= 7.3)	$\overline{x}$ = 41.36 (std=3.0)	$P \leq 0.04$	0.68
10. RC c-d	$\overline{x}$ = 36.31 (std = 4.7)	$\overline{x}$ = 33.14 (std = 5.4)	$p \leq 0.06$	0.46

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Discussion and conclusions

The research sample is characterized by a set of ten uncommon dermatoglyphic characteristics. Hence, the research has succeeded in attaining clear support for the proposition that an association exists between specific dermatoglyphics and the bereaved mothers.

Some of the dermatoglyphic characteristics observed in the current study were also found in other dermatoglyphic cases. In schizophrenia, for example, the ridge count between deltas A and B is reduced compared to healthy controls (Fananas et al., 1996). Broken creases were found in individuals diagnosed with psychosis (Rosa et al., 2002), and the separate radial starting points of the proximal and the radial creases in cases of infantile autism (Oron, 2014). But it should be noted that in order to characterize the complete dermatoglyphic set of the research group, you have to consider all the irregular features obtained, and not just one or two.

As to the limitations of the research, the main one is apparently its sample size. Dermatoglyphic analysis of seven women limits the ability to make broader generalizations from the results to the population of mothers bereaved by suicides. In addition, the results pertain exclusively to mothers whose offspring completed suicide but not to fathers. Nevertheless, the limitations are just an apparent drawback since the findings are meaningful, based on the statistical tests and, independently, on the levels of the effect size, and especially in the light of their potential contribution to suicide prevention.

As stated, the study aimed to conduct an exploratory search for preliminary evidence supporting an association between dermatoglyphics and parents of people who completed suicide. Hence, even though it is limited in size and scope it gives a first insight into the tested issue without providing definitive support for it. To put it differently, an exploratory study does not stand on its own. If it succeeds, it should always be followed by a main study. Thus, this small-sample research should be considered a prelude to a study on a larger scale.

Therefore, the results warrant replication and refinement in larger samples of bereaved parents of both genders. With further investigation, dermatoglyphic characteristics could lay the groundwork for a non-invasive method of screening out mothers and fathers whose offspring might have a disposition to complete suicide.

The results of this exploratory study definitely imply that a dermatoglyphic study is warranted with regard to those who completed suicide. Should a specific dermatoglyphic set emerge, it could lay the groundwork for a relatively quick method of identifying individuals at risk.

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