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DERMATOGLYPHICS, COORDINATION AND LITERACY IN PRIMARY SCHOOL: A CORRELATIONAL APPROACH

DERMATOGLIFIA, COORDENAÇÃO MOTORA E ALFABETIZAÇÃO NO ENSINO FUNDAMENTAL I: UMA ABORDAGEM CORRELACIONAL

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Resumo

Objetivo: Este estudo objetivou correlacionar características dermatoglíficas com a coordenação motora de escolares com (Y/LD) e sem dificuldades de alfabetização (N/LD). **Métodos:** Estudo transversal e descritivo com análise comparativa e correlacional. A amostra foi composta por 240 alunos (47,92% meninas), de 6 a 11 anos (7,51 ± 0,76), matriculados no 2º e 3º anos do ensino fundamental em Curitiba. Os testes aplicados foram: IMC; resultados das provas de Curitiba e análise do portfólio acadêmico; teste KTK para avaliação da coordenação motora; e dermatoglífia. Os resultados foram apresentados por estatística descritiva. **Resultados:** Foram observadas diferenças entre os grupos nos 4 testes KTK (p <0,01), bem como no quociente motor total (z = 0,258, p <0,01) e no escore total (z = 0,240, p <0,01). Não foram observadas diferenças significativas entre as variáveis dermatoglíficas. Os resultados do KTK se correlacionaram fortemente entre os grupos Y/LD e N/LD (t (238) = 5,976, p <0,01, d = 0,79). **Conclusões:** O estudo reforçou a tese de que pode haver uma estreita relação entre as dificuldades de coordenação motora e alfabetização.

Palavras-chave: Dermatoglifia, coordenação motora, dificuldades na alfabetização, "Körperkoordinationstest für Kinder" KTK

Abstract

Objective: This study aimed to correlate dermatoglyphic characteristics with motor coordination of students with (Y/LD) and without literacy difficulties (N/LD). **Methods**: This is a cross-sectional and descriptive research, with comparative and correlational analysis. The sample consisted of 240 students (47.92% girls), aged between 6 and 11 years (7.51±0.76), dully enrolled in the primary 2nd and 3rd school years from Curitiba. Students were assessed by the following protocols: BMI; Curitiba test results, academic portfolio analysis, KTK test for motor coordination evaluation and dermatoglyphics. Results were presented using descriptive statistics. **Results**: Differences between groups were observed all 4 KTK tests (p< 0.01), as well as in the total motor quotient (z= 0.258, p< 0.01) and total score (z= 0.240, p< 0.01). No significant differences were noted between the dermatoglyphic variables. KTK results were strongly correlated with the Y/LD and N/LD groups (t (238) = 5.976, p< 0.01, d= 0.79). **Conclusions**: The study reinforced that there may be a close relationship between motor coordination and literacy difficulties.

Key-words: Dermatoglyphics, motor coordination, literacy difficulties, "Körperkoordinationstest für Kinder" KTK test.

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INTRODUCTION

Recognizing possible disorders in the literacy process in the aim of mediating their resolution as early as possible can be a determining factor for school success [1], [2]. However, academic performance should not be restricted to a purely intellectual or memory process, or to new knowledge acquisition over a previous cognitive structure; there are many other variables that take part on this process, as explored the theory of multiple intelligences proposed by the psychologist Howard Gardner [3].

Thus, it is known that difficulties in the teaching-and-learning process can be minimized with the use of pedagogical tools from different knowledge areas. For example, in Physical Education, where the diagnosis of motor difficulties usually occurs more easily than in other areas [4].

Recent studies have directed towards a possible relationship between coordinating patterns and academic performance [5], [6]. Pinto [7], Carvalho *et al*. [8] and Fernandes Filho *et al*. [9] reinforce the theory that children with learning difficulties also show coordinative disorders.

Considering the above, one concern comes into mind: why do students with coordination disorders, in general, also present difficulties in academic performance? Knowing that the coordinative potential seems to be related to certain genetic patterns [10], [11], [12], [13], could there be any difficulties within the educational process, more specifically regarding literacy, also related to genetic factors?

Studies carried out in the field of genetics point towards a positive relationship between dermatoglyphic patterns and the predisposition for coordinating capacities [14]. Also, fingerprints, as genetic markers, are considered indicators of the main parameters of endowments and motor talents [10], [15]. These same authors affirm that the development of motor skills may be related not only to environmental factors, but also to personal genetic characteristics.

Understanding that motor difficulties can be anticipated through the analysis of both innate characteristics (dermatoglyphic analysis) and phenotypic characteristics, different possibilities are opened for minimizing possible learning disorders, such as difficulties in the literacy process, which would certainly positively influence the academic development processes.

Therefore, for a better understanding of these phenomena, the present study sought to correlate dermatoglyphic characteristics and coordinative levels of primary school students who present difficulties in the literacy process with those who do not present difficulties in literacy.

MATERIALS AND METHODS

This is a cross-sectional and descriptive research of comparative and correlational design. The sample was recruited at random from four different public schools in Curitiba, and consisted of

240 students (125 boys and 115 girls), aged between 6 and 11 years (7.51 ± 0.76), dully enrolled in the 2nd and 3rd primary school years.

All those responsible for the participating students were duly informed about the objectives and protocols used and signed a Free and Informed Consent Letter. The research was approved by the Ethics Committee for Research with Humans of the Federal University of Rio de Janeiro - UFRJ (CAEE 04195118.9.0000.5257), in accordance with the Helsinki Declaration.

Data collection took place in the morning and afternoon shifts, during the school period, between the months of February and July of 2019, according to the availability of students' access to the tests. Each student was evaluated individually, in a suitable room, in order to avoid distractions.

First of all, the age and sex of each student were recorded; then the data collection procedures were carried out, and involved the following steps: 1) total body mass and height were measured for body mass index – BMI determination; 2) the collection of fingerprints was carried out, using the dermatoglyphic method proposed by Cummins & Midlo [16] and the results were expressed qualitatively, according to the predominance of each type of fingerprint: the incidence of arches (A), loops (L) or whorls (W); and quantitatively, by the variables delta 10 index (D10) and total quantity of lines (TQL); 3) application of the Coordination Test for Children '*Körperkoordinationstest Für Kinder*' – KTK, proposed by Kiphard and Schilling [17], where each individual had to perform each of the 4 tests the KTK protocol involvers, as it follows: balance beam, single foot jumps, side jumps, and platform side transposition; and 4) identification of students with literacy difficulties by using two instruments: the evaluation of the students' results from *Curitiba* education department test, and the analysis of the individual portfolio of each student.

All tests were carried out by the same evaluator, thus avoiding inter-evaluator mistakes. All data was tabulated using Microsoft Excel® software, while the data analysis was performed using SPSS 26.0®, TIBCO Spotfire® for graph construction and Adobe® for graph editing.

Once tabulated, the data treatment was performed by using descriptive statistics with minimum, maximum, average and standard deviation (SD) values. For checking the differences between variables, Student *t* test was used, with a significance level set at $p \leq 0.01$. For analysing the degrees of association between variables, Pearson's correlation test was used. Such procedure was chosen after the normality of the data being tested and checked, suggesting parametric statistics. The degree of reliability established for all statistic treatment was $p \leq 0.01$.

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RESULTS

Table 01 presents the mean, SD, minimum and maximum values for the anthropometric, KTK and dermatoglyphic variables.

TABLE 01. Descriptive statistics of anthropometry, KTK and dermatoglyphics.

	N	Mean and percentage values	Min.	Max.
Total body mass (kg)	240	30.59 ± 7.72	16.6	56
Height (m)	240	1.27 ± 0.06	1.13	1.47
BMI	240	18.74 ± 3.64	12.34	29.33
Sum MQ1	240	29.47 ± 13.74	0	60
Score MQ1	240	83.70 ± 14.96	49	121
Sum MQ2	240	27.78 ± 13.92	0	62
Score MQ2	240	86.17 ± 15.36	54	130
Sum MQ3	240	40.08 ± 12.38	0	74
Score MQ3	240	95.40 ± 16.24	47	136
Sum MQ4	240	37.17 ± 6.99	0	58
Score MQ4	240	98.82 ± 15.06	39	136
Total MQ	240	364.09 ± 49.94	205	471
Final KTK Score	240	88.28 ± 16.09	40	123
A	240	4.6%		
L	240	63.9%		
W	240	31,5%		
D10	240	12.68 ± 3.52	3	20
TQL	240	133.5 ± 42.33	7	232

MQ = motor quotient; A = Arch; L = Loop; W = Whorl; D10 = Delta 10 index; TQL = total quantity of lines

When splitting the sample into two different groups: with literacy difficulties (Y/LD) and without literacy difficulties (N/LD), it was noticed that the average values for both age and anthropometry variables were not statistically different (TABLE 02), which exposes the homogeneity of the sample.

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TABLE 02. Age and anthropometry mean values

	Group (N/LD = 1; Y/LD=2)	N	Mean
Age	1	150	7.52 ± 0.72
	2	90	7.50 ± 0.84
Total body	1	150	30.90 ± 8.02
mass	2	90	30.07 ± 7.22
Height	1	150	1.27 ± 0.06
	2	90	1.25 ± 0.07
BMI	1	150	18.70 ± 3.82
	2	90	18.79 ± 3.35

TABLE 03. Mean values for KTK tests of both groups

	Group (N/LD = 1; Y/LD=2)	N	Mean	Deviation error
Sum MQ1	1	150	32.55	13.16
	2	90	24.33*	13.20
Score MQ1	1	150	86.94	14.80
	2	90	78.31*	13.69
Sum MQ2	1	150	31.07	13.02
	2	90	22.31*	13.70
Score MQ2	1	150	89.91	14.78
	2	90	79.92*	14.30
Sum MQ3	1	150	42.73	11.83
	2	90	35.64*	12.07
Score MQ3	1	150	99.05	15.91
	2	90	89.30*	14.99
Sum MQ4	1	150	38.35	5.67
	2	90	35.04*	8.37
Score MQ4	1	150	101.64	13.86
	2	90	94.13*	15.89
Total MQ	1	150	377.55	46.63
	2	90	341.67*	47.39
Final KTK	1	150	92.61	15.08
Score	2	90	81.09*	15.19

* The difference is significative at the level of $p \leq 0.01$

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Table 03 presents the analysis of the responses to the KTK in the isolated 4 tests. Differences were noted between the groups Y/LD and N/LD in all 4 tests applied, as well as in the total quotient (z= 0.0258, *p*< 0.01) and total score (z= 0.240, *p*< 0.01), suggesting that students with no literacy difficulties were able to perform better than the other group in the KTK tests. Such differences can also be seen in Figure 01.

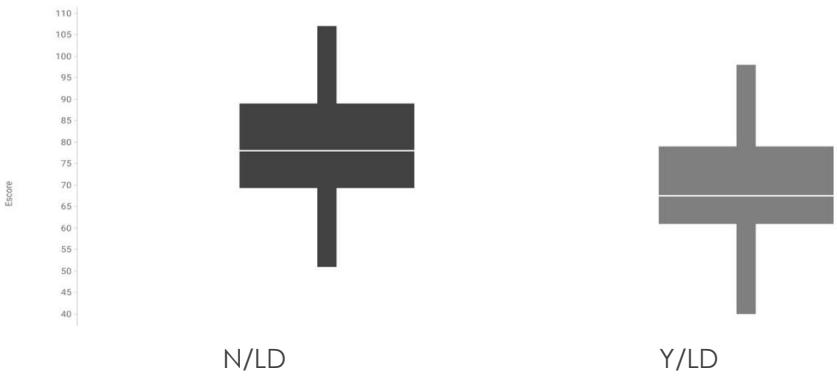

FIGURE 01. Differences observed in the KTK final score results.

The descriptive results for the dermatoglyphic variables are presented in Table 04, for both N/LD and Y/LD groups, respectively.

TABLE 04. Percentage and mean values for dermatoglyphic variables

	Group (N/LD = 1; Y/LD=2)	N	Mean and percentage values
A	1	150	3.5%
	2	90	6.4%
L	1	150	64.5%
	2	90	62.9%
W	1	150	31.9%
	2	90	30.7%
D10	1	150	12.83 ±.270
	2	90	12.41 ±.406
TQL	1	150	130.20 ±3.240
	2	90	125.59 ±4.903

TABLE 05. Test of independent samples for differences between groups observed in dermatoglyphic indicators

	Levene's test for equality of variances		Student-*t* test for equality of means						
								95% Confidence Interval for Difference	
	Z	Sig.	t	df	Sig. (2 tail)	Mean difference	Std. Error	Lower Bound	Upper Bound
A	11.949	.001	-1.857	238	.065	-.291	.157	-.600	.018
			-1.634	124.449	.105	-.291	.178	-.644	.062
L	.139	.709	.429	238	.669	.158	.368	-.567	.883
			.423	180.262	.672	.158	.373	-.578	.893
W	.007	.932	.323	238	.747	.127	.392	-.646	.899
			.320	181.210	.750	.127	.396	-.655	.909
D10	1.395	.239	.899	238	.370	.422	.470	-.503	1.348
			.866	166.018	.388	.422	.488	-.541	1.385
TQL	3.281	.071	.816	238	.415	4.611	5.649	-6.518	15.740
			.785	164.912	.434	4.611	5.877	-6.993	16.216

No significant differences in the dermatoglyphic variables between the two groups were noted; the fingerprints configuration (A, L, W), D10 or TQL did not present any significant difference between the groups with and without literacy difficulties. The configuration A was the only variable which almost showed a relevant difference, however, considering the incidence of A was low in both groups (below 7%), it is not possible to affirm that there was a significant difference between groups for such variable.

When correlating the results of the dermatoglyphic variables A, L, W, D10 and TQL with the results of the KTK tests, no correlations were observed. Only the KTK results showed a strong relationship (t (238) = 5.976, p <0.01, d = 0.79), as seen in Table 03.

DISCUSSION

The relationship between dermatoglyphics and academic performance has been little explored in the literature so far. Najafi [18] studied the association between dermatoglyphic patterns and academic performance of 342 adolescents from Shahrekord, Iran, all subdivided into three different groups: 144 classified as talented, 102 as with normal development, and 96 with learning difficulties, based on their intelligence quotient (IQ) level. In this research, the dermatoglyphic analysis was restricted to the index finger (finger II) of both right and left hands. The results showed a predominance of whorls both right and left fingers in all 3 groups, therefore, no significant differences were observed for the dermatoglyphic variables between the 3 groups, which led the author to suggest new studies involving the theme.

On the other hand, Offei *et al.* [19] analysed fingerprints and handprints of 320 3rd and 4th grade students from a school in Ghana, using the FBI's classification system for fingerprints. The dermatoglyphic patterns of each student were compared to their academic results from five consecutive academic periods. The study revealed that students with symmetrical palmar dermatoglyphic characteristics presented higher academic performance than those with asymmetric characteristics ($p< 0.001$). Surprisingly, students with the prevalence of L and W configurations in the ring and middle fingers achieved better academic results than those with the prevalence of A ($p< 0.0001$). Such results point towards a close association between dermatoglyphic patterns and cognitive functions, suggesting that the A configuration may be correlated with lower academic performance and therefore, dermatoglyphics could be used to identify students with potential of having difficulties in the literacy process.

Lakshimi Kumari *et al*. [20] also sought to verify the relationship between dermatoglyphics and intellectual performance by comparing the dermatoglyphics of 94 students in the first year of medical graduation to that of 80 students also in the first year of technical courses in the medical area, both groups belonging to the same educational institution in India. The results showed a predominance of ulnar loops on the left-hand fingers of both groups, and no significant differences were noted between the groups. But, as a limitation of their study, it should be noted that the authors did not use any protocol for assessing the academic performance of the sample, and were based only on the assumption that undergraduate medical students would perform better in terms of intelligence level than those from technical courses.

In this same line, Adenovo & Dare [21] also found associations between dermatoglyphic parameters and academic performance of medical students. In their study, they evaluated 65 students (30 men and 35 women) who were in their third year of medicine at Bingham University, Karu, Nigeria. Students were classified into 3 groups (good, average and poor), according to their academic performance throughout the course. It was observed the prevalence of ulnar loops in the 3 groups, and symmetrical lines configurations in right and left hands among the students in the group classified as "good". The incidence of A was not observed among students in the "good" group,

while in the group classified as "weak", more than 2 types of finger configurations were observed, as well as asymmetric lines arrangements. Furthermore, no significant differences were observed for the TQL between the 3 groups ($p< 0.05$), which corroborates with the data observed in this study.

Specifically, regarding the relationship between dermatoglyphics, coordination levels and literacy difficulties, Luna [22] assessed 61 children (6 and 7 years old) in north-eastern Brazil. In his study, the sample was subdivided into 2 distinct groups: 37 students with no literacy difficulties and 24 students with difficulties; these groups were then compared in terms of motor coordination and dermatoglyphics. The performance of the group with literacy difficulties was 75% lower than the group without difficulties. In the dermatoglyphic analysis, a higher incidence of A and low D10 and TQL were observed, respectively, in children with literacy difficulties ($p< 0.05$). Such results expose a possible correlation between dermatoglyphics, motor coordination and difficulties in the literacy process.

Studies on dermatoglyphics developed in Russia and in Brazil throughout the years [10], [13], [14], [23], [24], [25] reflect the relationship between some dermatoglyphic variables and high coordination levels. They are: the prevalence of whorls (W), delta index 10 (D10) close to 10 and total number of lines (TQL) close to 200. Likewise, low values of D10, TQL, and the prevalence of arches (A) seem to correlate with low coordinating levels, but with optimized pure strength and speed.

This study did not observe significant correlations between dermatoglyphic variables and coordinative levels between the groups with and without literacy difficulties, which contrasts with the literature developed so far. Such phenomenon can be explained by two perspectives: 1) the sample was selected at random, while most of the studies that correlate dermatoglyphics and coordinating levels use samples selected intentionally (i.e. high-performance athletes), who have both genotypic and phenotypic refined aspects. As the incidence of A in the sample of this study was low (> 7%) and, aware that the prevalence of such configuration has a strong relationship with low coordination levels [10], [14], perhaps a larger sample size, selected intentionally, and with a higher incidence of A, would be able to show such correlation.

Another hypothesis lies in the fact that the design of this study is cross-sectional, and therefore no information regarding the stimuli to which the sample was subjected throughout life was accessed. Therefore, it is assumed that individuals with a low coordinative genetic potential may have been well stimulated, which would overcome possible genetic difficulties.

CONCLUSIONS

The results here presented suggest that coordinative characteristics are related to difficulties in the literacy process ($p< 0.01$). And, based on the scientific literature produced in the last decades, it is understood how certain dermatoglyphic patterns are able to predict the coordinative genetic potential of children. In this study, the relationship between motor performance and literacy difficulties was verified, but not between these variables and dermatoglyphics. However, the arch

(A) fingerprint configuration was the only dermatoglyphic variable close to a positive relationship with low coordination levels and literacy difficulties: 6.4% of students with difficulties and 3.5% of students without difficulty. This can be explained both by the low incidence of A within the sample and by uncontrolled variables, such as the level of motor stimuli that each child received from conception (phenotype).

Given this, it is understood that the recognizing of the genetic potential of children, especially those in the first school years, may be a powerful tool for overcoming possible coordination difficulties that may arise. Once recognized what is and what is not genetically potentialized (genotype), allied to varied and adequate motor stimuli (phenotype), it may reflect positively in terms of minimizing possible difficulties that may be manifested in students' academic performance, especially with regards to literacy.

To reinforce the theory proposed in this study, it is recommended to develop additional research with samples of great magnitude and from different regions, as well as the development of longitudinal studies that control intervening variables in the aim of elucidating the relationships between dermatoglyphic characteristics, coordinative potential and literacy difficulties.

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