

Role of Palmar ATD Angle in Screening Autism

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Abstract

ATD angle is important dermatoglyphic trait that is being used for medical purposes. The study aimed at determining the ATD angle of autistic and control subjects in Nigeria. A total of 200 subjects was used, 100 autistic (82 males and 18 females) and 100 (65 males and 35 females) control subjects. The subjects were selected from various special schools in Nigeria using convenient sampling. Scanning method was used to collect the data. After that an Autocad software was used to measure the three tri-radii on the palm to get Atd angle. The data obtained were analysed using SSPS and Mann-Whitney U test was used to test for the results. The result showed a lower atd angle for autism than control subjects for both sexes and both hands and for females' subjects. However, the left hand of male autistic subjects showed higher Atd angle when compared to the control subjects. The results revealed no significant difference between the Atd angle of autistic and control subjects ($P > 0.05$) in Nigeria. Conclusively, the study deduced that ATD angle alone may not be enough in screening autism as it may not differentiate autism from control.

Keywords: ATD angle, Dermatoglyphics, Autism, Screening, Nigeria.

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INTRODUCTION

Dermatoglyphics as one of the physical anthropological features can be used for early detection/diagnosis of diseases (Oladipo *et al.*, 2009; Osaat *et al.*, 2019). Studies have shown its crucial role in the early diagnosis of genetic diseases (Verbov, 1970; Mollik and Habib, 2011, Osaat, 2025). This is particularly factual because it has been established that the ridges on the fingers and palm are slightly different in individual and no two persons have exactly the same print patterns (Reed *et al.*, 1978). These ridges as well as the print patterns are constant throughout the life of an individual which makes a person unique and special (Sandeep *et al.*, 2012; Jeewandeep & Arvinder, 2013).

There are about three different angles on the palms of the hands which are 'atd' angle, 'dat' angle and 'adt' angle. These angles are formed as a result of triradii points on the palm which are, t, a, b, c, and d triradii points. These triradii points joined to form the different angles. According to studies, these angles are traits that are very useful for medical purposes, like diabetes mellitus (Sheprala *et al.*, 2023). Atd angle is the angle formed by drawing lines from the digital tri-radius 'a' to axial tri-radius 't' and then the digital tri-radius 'd' (Brunson *et al.*, 2015). The more distal the position of 't' the larger the atd angle (Pratibha *et al.*, 2011). Sometimes

two or three axial triradii (t) may be seen on the palm. When it occurs near the centre of the palm it is called 't', and when it is seen between 't' and t, it is called 't'. Atd angle depends on the position of the axial triradius and it is a useful measurement to quantify the position of the most distal axial triradius (Verbov, 1970). Atd angle varies among individuals ranging between 38° – 55° with 48° average among normal individuals and average 81° among Down's syndrome individuals (Fogle, 1990). A larger atd angle is correlated or associated with Down's syndrome disorder (Sheetal *et al.*, 2020). Also for autism, reports showed varied atd angle (Stosljevic and Adamovic, 2013; Milicic *et al.*, 2003).

Studies also reported that Atd angle is also an important trait that is being used for various purposes. According to Sheetal *et al.*, (2020) 'atd' angle is smaller in physical education students as compared to non-physical education students. Though they suggest a preferable measurement of 'atd' angle in individuals prior to selection in sports, however the differences between these two groups was not statistically significant. Also, researchers have described 'atd' angle as 'intellectual angle' or 'wisdom corner' (Sheetal *et al.*, 2020). It is generally accepted that the smaller the value of 'atd' angle, the higher the level of intelligence. Researchers have shown that an angle of 50 degrees suggests that the individual is mentally retarded. Brunson

et al., (2015) tested the reliability of the ATD angle and found out that ATD angle is highly reliable tool in dermatoglyphics.

Correlations between dermatoglyphics and some disorders that have genetic origin have been documented such as autism (Stosljevic and Adamovic, 2013; Oladipo *et al.*, 2013) and Down's syndrome (Tarca & Barabolski, 2003; Sharma *et al.*, 2012), mental retardation (Stevenson *et al.*, 1997), due to the fact that genetic and uterine environmental events influence dermal pattern formation and so genetic anomalies in the process leave markers in the ridge pattern.

Autism is a neuro-developmental disorder which is associated with social and communication impairments (Caronna, 2008), that is, the inability to relate normally, to form normal social relationships or to communicate normally (Manning *et al.*, 2003). According to Autism speaks (2016), autism do not have only one cause, it's recently believed to be a result of both genetic and environmental factors (Beaudet, 2007). The genetic basis of autism is strong and obviously complex to understand (Abraham & Geschwind, 2008; Buxbaum, 2009). The complexity can be as a result of various factors contribution such as interactions among multiple genes, the environment (Beaudet, 2007) and epigenetic factors. All these factors do not change DNA but are heritable and influence gene expression (Rapin, 2008).

Based on this, this study seeks to determine the Atd angle of autistic subjects in Nigeria.

METHODOLOGY

Research design

The design for this research is the descriptive sample survey method. This research was carried out in some selected cities in Nigeria such as Lagos, Abuja and Port Harcourt.

Research Population

This study comprised both male and female autistic and Down's syndrome subjects in Nigeria. Age

ranged between 5 to 35 years of age. There was no documented statistical record on the population of autistic and Down's syndrome subjects in Nigeria. However, Bakare *et al.*, (2012) reported prevalence rate of 0.7% for autism in Nigeria and Adeyokunnu (1982) reported for Down's syndrome the prevalence rate of 1 in 865live births.

The minimum sample size for autism was 47, however the sample size used for this research study was 100 (82 males and 18 females) for autism. Control subjects used was 100 (65 males and 35 females).

Sampling Technique and Subjects Selection

The sampling technique used for this research was convenience sampling technique. This is as a result of the difficulty in getting the children due to fear of stigmatization. The subjects who met the inclusion criteria were selected from various special schools within the study area. Information needed for the selection of the subjects was obtained directly from the occupational therapists, care-givers or teachers which were supported by the physical observations of the researcher. An informed consent which contains details of the research work was issued out and clarifications given were necessary before the commencement of work.

Methods of Data Collection and Determination

The dermatoglyphic patterns were collected and determined using the scanning method according to Oghenemavwe & Osaat (2015). The subjects' fingers and palms were thoroughly washed with water and soap and dried with clean towel to remove dirt. The subject was asked or assisted to place the washed palms on the scanner and accordingly the palms were scanned. The scanned images were saved in a folder. Later on, collation of raw data was obtained from the scan images and used for further analysis.

Angles were done using AUTOCAD Program. The Autocad program automatically measured the angles after a line drawn between two tri-radial. "atd" angle is measured between 'a', 't' and 'd' tri-radial points for both hands.



Fig. 1: Scanned palms

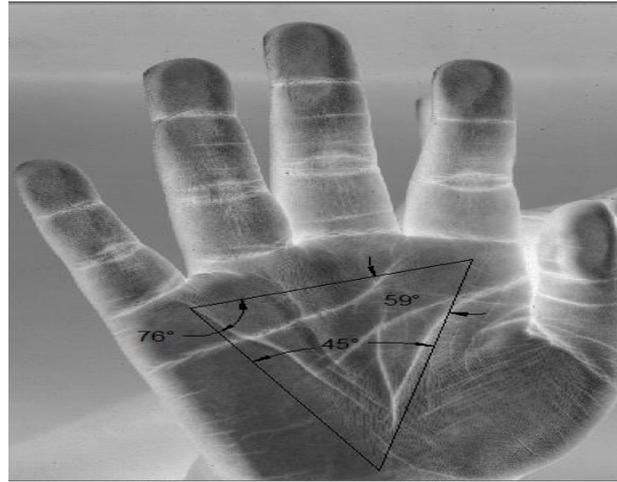


Fig. 2: Autocad software used to measure angles

Method of Data Analysis

The data obtained from this study were subjected to test using SPSS (Statistical Package for Social Science IBM ® Version 23 New York). Mann-Whitney U test analysis was used to analysis the results. All statistical testing was done at 95% confidence level with p-value less than 0.05(p< 0.05) taken to be significant.

Ethical Consideration

Prior to commencement of the research work, ethical approval was sought from the Research Ethics Committee of the School of Graduate Studies, University of Port Harcourt in form of proposal writing and it was approved with reference number UPH/CEREMAD/REC/04. In addition, informed consent was obtained from the parents/guidance and institutional authorities of the subjects by signing a

consent form given to them before samples of the subjects under study were taken.

RESULTS

As shown in table 1, Mann-Whitney U test was used to test for differences between the atd angle of autistic subjects and normal subjects on the right and left hands of both sexes. The result showed that ATD was not statistically significant between autistic and normal subjects of both sexes (p>0.05). Table 2, revealed that ATD angle on both hands were not statistically significant -between male autistic and male normal subjects (p>0.05). In table 3, the result showed that ATD angle on both hands were not statistically significant between female autistic and female normal subjects (p>0.05).

Table 1: Mann-Whitney U test comparing the right and left dermal angles of Autistic and Normal Subjects of both sexes

	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	P-value
Right ATD	AU Subjects	100	99.20	9919.50	4869.50	9919.50	-0.32	0.75
	NO Subjects	100	101.81	10180.50				
Left ATD	AU Subjects	100	97.06	9706.00	4656.00	9706.00	-0.84	0.40
	NO Subjects	100	103.94	10394.00				

Note: AU-Autism, NO-normal, df-degree of freedom, *-significant, z-z score, ATD angle

Table 2: Distribution of the right and left dermal Angles and test of association in males of autistic and normal subjects

	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	P-value
Right ATD	AU Finger	75	71.32	5349.00	2376.00	4521.00	-0.26	0.80
	Normal Finger	65	69.55	4521.00				
Left ATD	AU Finger	75	68.07	5105.00	2255.00	5105.00	-0.76	0.44
	Normal Finger	65	73.31	4765.00				

Note: AU-Autism, NO-normal, df-degree of freedom, *-significant, z-z score, ATD angle

Table 3: Distribution of the right and left dermal angles and test of association in females of autistic and normal subjects

	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	P-value
Right ATD	AU Finger	25	27.86	696.50	371.50	696.50	-0.99	0.32
	Normal Finger	35	32.39	1133.50				
Left ATD	AU Finger	25	29.24	731.00	406.00	731.00	-0.47	0.64
	Normal Finger	35	31.40	1099.00				

Note: AU-Autism, NO-normal, df-degree of freedom, **-significant, z-z score, ATD angle

DISCUSSIONS

ATD angle have been found to be very useful especially for medical purposes. A wide angle is always seen in malformations or disorders like Down's syndrome. In the present study, a lower ATD angle was observed for autistic subjects than control subjects though it the difference was not significant for both sexes on both hands. Walker (1977) and Sanyaolu *et al.*, (2011) reported similar findings of lower ATD angle in autistic subjects than control which may possibly be the result of congenital interference in their development. Oladipo *et al.*, (2007) also reported a lower ATD angle for sickle cell anaemia when compared to their controls. However, Asutosh *et al.*, (2025) had different observation of highly statistically significant values in the mean atd angle of the right hand of cervical cancer patient (40.07± 3.24) compared to control (44.57±6.39) and also left hand of cervical cancer patient (41.49± 4.07) compared to control (46.88±7.83).

From the present study, the ATD angle of the right hand of male autistic subjects was higher than the control while that of the left hand was lower than the control subjects. In line with the present study, Stosljevic & Adamovic (2013) reported a wider ATD angle for autistic boys than control. Also, Ozyurt *et al.*, (2010) observed that the male schizophrenia have a significantly lower ATD angle especially on the left hand compared to the male control.

The present study observed lower ATD angle for the female autistic subjects when compared to the controls. In contrast, Arrieta *et al.*, (1990) reported a wider ATD angle for autistic girls than control. This result agrees to the fact that environmental factors can play significant role in the etiology of unknown origin of autism (Rejeb & Namouchi, 2010; Stosljevic & Adamovic 2013). The male subjects have higher atd angle than the female subjects. Sexual dimorphism observed. The sex differences observed in this study suggest that males have greater prenatal susceptibility to neurodevelopment instability and they tend to be more environmental sensitive than the female because their prenatal growth is more affected by stress (Murray, 1991).

In general, the present study showed there was no statistically significant difference between autistic subjects and control subjects. This implies that various

factors contribute to the etiology of autism and that its genetic bases is complex to understand seeing that there was no difference exist between the atd angle of autism and control. According to Hartin & Barry (1979) conclusions of unique congenital disturbance in the etiology of autism inferred from different dermatoglyphics may be premature, and that dermatoglyphics may be ineffective in delineating autistic children from other atypical populations. However, according Nayeem *et al.*, (2025) the ATD angle was significantly increased in healthy children when compared to autistic children ($p < 0.001$ for each group). The result is in contrast to the present study and may likely be as a result of the number of samples they used or as result of the change in method in the present study. This overall result agrees to the fact that genetic influence contributes minimally to the etiology of autism (Stosljevic & Adamovic, 2013).

CONCLUSION

Dermatoglyphics is known to be a good inexpensive tool in screening various genetic disorders. From the present study, Autism a neuro-developmental disorder was observed to have a lower ATD angle when compared to control subjects, and the difference was not statistically significant. This implies that ATD angle alone may not be enough in screening autism as it may not differentiate autism from control.

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