



RESEARCH ARTICLE

COMPARISON OF DERMATOGLYPHIC FINGER RIDGE COUNTS OF IGBO AND OKRIKA PEOPLE OF SOUTHERN NIGERIA

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ARTICLE INFO

Article History:

Received 22nd July, 2017
Received in revised form
17th August, 2017
Accepted 08th September, 2017
Published online 17th October, 2017

Key words:

Finger,
Ridge Counts,
Igbo,
Okrika.

ABSTRACT

Background: The term dermatoglyphics is coined from two Greek words `DERMA` and `GLYPHE` which means skin and carve respectively, which refer to the friction ridge formation that appears on the palms of the hands and soles of the feet. Dermatoglyphics has found application in establishing ethnic differences. Finger ridge counts are important for identification of an individual's true identity. There is dearth of information on the Finger Ridge Counts of the Igbos' and Okrikas' in Southern Nigeria.

Aim and Objective: This study was aimed at determining the Finger Ridge Counts of the Igbos' and Okrikas' in Southern Nigeria.

Materials and Methods: The study was non-experimental and analytical. A total of two hundred subjects were used for the study. 100 Igbos and 100 Okrikas, all of which were normal subjects. These subjects were randomly selected through simple random sampling method from Igbo and Okrika Population. One-way Anova test was done using Statistical Package for the Social Sciences (SPSS 20.0 version).

Result and Discussions: The test of significance revealed significant differences between the distribution of Right ring finger and Left little finger of Igbo and Okrika subjects ($P < 0.05$). The study showed in the distribution of the ridges amongst the Igbos where the males had higher distributions than the female subjects consistently. In the Okrika population, sexual dimorphism was not prominent as was seen in the Igbo population. On comparison the Igbos had higher mean ridge count in the ridge distribution than Okrikas which may be attributed to the difference in genetic make-up of both tribes. The ADT angles revealed that the Okrikas' had higher values than the Igbos consistently in both sexes which could be explained to be a result of difference in the genetic make-up of both tribes.

Conclusion: This study established handedness, sexual dimorphism in ridge distribution, a trend in the ADT angular dimensions of the hand and revealed that both tribes are distinct and unique in their genetic makeup as such are unrelated by any means in their ancestry and the little similarity in the ridge distribution could only have occurred by chance.

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Citation: Oladipo Gabriel Sunday, Alabi Ade Stephen, Paul Chikwuogwo Wokpeogu et al. 2017. "Comparison of dermatoglyphic finger ridge counts of igbo and okrika people of Southern Nigeria", *International Journal of Current Research*, 9, (10), 58709-58713.

INTRODUCTION

Dermatoglyphics has found application in establishing ethnic differences (Harlich et al., 2002). The term dermatoglyphics is coined from two Greek words `DERMA` and `GLYPHE` which means skin and carve respectively, which refer to the

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friction ridge formation that appears on the palms of the hands and soles of the feet, it was first introduced by Cummins in 1926. Finger ridge patterns are important for identification of an individual's true identity despite personal detail, assumed name, change in personal appearance as a result of age, disease, surgery or accident or race. The practice of utilizing fingerprints as a means of identification is referred to as Dactyloscopy. The Igbo people, historically spelled Ibo, are an ethnic group of south eastern Nigeria. They speak Igbo, which

includes various Igbo languages and dialect. Igbo people are one of the largest ethnic groups in Africa with a population of 22,000,000. In rural Nigeria, Igbo people are mostly craftsmen, farmers and traders. The Igbos in Nigeria are found in Abia, Anambra, Ebonyi, Enugu, Imo States. Okrika is a port town in Rivers State, Nigeria, capital of the Local Government Area of the same name. The town is situated on a small island just south of Port Harcourt, making it a suburb of the much larger city. Formerly a small fishing village of the Ijo (Ijaw) people in the mangrove swamps of the eastern Niger River delta, with a population of 410,000 who are predominantly farmers and fishermen whose local dialect is Kirike language. There is dearth of information on the Finger Ridge Counts of the Igbos' and Okrikas' in Southern Nigeria. Aim and Objective: This study was aimed at determining the Finger Ridge Counts of the Igbos' and Okrikas' in Southern Nigeria. Scope of the Study: This study was done specifically on the Finger Ridge Counts.

MATERIALS AND METHODS

Research Design: The study was non-experimental and analytical. A total of two hundred subjects were used for the study. 100 were Igbos (49 males; 51 females), 100 were Okrikas (49 males; 51 females), all of which were normal subjects. These subjects were randomly selected through simple random sampling method from Igbo and Okrika Population.

Data Collection: The fingers ridge counts were determined using a classical scanner type, Hp G3110 Scanjet Scanner (9000x4800 dpi resolution) to obtain a clear and visible print which was transferred to the laptop via a USB cord. The prints were zoomed for clarity after thoroughly examined and counted. Hands were cleaned from dirt before taking prints and a little pressure was put to press the fingers on the scanner for adequate contact between the fingers and the scanner to have a clear image of the print and the prints were taken twice. Subjects included in this study were those without finger or

hand deformities and subjects who were either Igbos or Okrikas by both parents and genealogies. Those who have finger or hand deformities or have had surgical procedure on their finger/hand were excluded. The sample population was calculated using Fisher's formula for large population greater than 10,000.

Statistical Analysis: one-way Anova using Statistical Package for the Social Sciences (SPSS 20.0 version).

RESULTS

In table 1 the male subjects of the Igbos had the following mean distributions: on the right hand, the highest mean value was 17.294 ± 5.273 and on the left hand, 15.352 ± 4.898 which occurred both on the ring finger. The least mean value on the right hand was 11.288 ± 7.784 on the thumb and on the left hand 11.058 ± 6.175 which occurred on the index finger. The female subjects of the Igbos had the following mean distributions: on the right hand, the highest mean value was 15.530 ± 5.919 and on the left hand, 13.653 ± 5.076 which occurred both on the ring finger. The least mean value on the right hand was 10.530 ± 6.487 and on the left hand 9.857 ± 6.445 which occurred both on the index finger. In table 2 the male subjects of the Okrikas had the following mean distributions: on the right hand, the highest mean value was 15.020 ± 4.879 and on the left hand, 13.857 ± 5.541 which occurred both on the ring fingers. The least mean value on the right hand was 10.836 ± 6.128 on the index finger and on the left hand 10.734 ± 7.915 on the thumb. The female subjects of the Okrikas had the following mean distributions: on the right hand, the highest mean value was 14.059 ± 4.931 and on the left hand, 13.156 ± 5.839 which occurred both on the ring finger. The least mean value on the right hand was 11.470 ± 6.836 and on the left hand 9.431 ± 5.741 which occurred both on the index finger. In Table 3 the test for differences in the finger ridge counts for both the right and left hands of all Igbo and Okrika subjects. The test revealed

Table 1. Descriptive statistics of right and left finger ridge count of Igbo subjects

Finger	Sex	Right Ridge Count		Left Ridge Count	
		Mean	Standard Deviation	Mean	Standard Deviation
Thumb	M	11.8824	7.9841	11.7451	8.3470
	F	11.7347	7.7372	11.6459	8.3316
Index Finger	M	12.5294	6.5279	11.0588	6.1754
	F	10.5306	6.4874	9.8571	6.4452
Middle Finger	M	13.1373	6.1286	11.3265	6.1657
	F	12.6327	5.4148	10.7347	6.1946
Ring Finger	M	17.2941	5.2736	15.3529	4.8982
	F	15.5306	5.9199	13.6531	5.0767
Little Finger	M	13.8431	5.5834	13.0392	4.6859
	F	13.5510	5.1318	12.5918	4.2176

(P<0.05), F-Female, M- Male

Table 2. Descriptive statistics of right and left finger ridge count of Okrika subjects

Finger	Sex	Right Ridge Count		Left Ridge Count	
		Mean	Standard Deviation	Mean	Standard Deviation
Thumb	M	11.551	7.018	10.734	7.915
	F	11.490	6.210	11.666	6.121
Index Finger	M	10.836	6.128	9.775	6.080
	F	11.470	6.836	9.431	5.741
Middle Finger	M	11.449	5.315	11.509	4.989
	F	11.529	4.342	11.354	5.770
Ring Finger	M	15.020	4.879	13.857	5.541
	F	14.059	4.931	13.156	5.839
Little Finger	M	13.755	4.913	13.265	4.498
	F	12.549	4.225	11.012	4.715

(P<0.05), F-Female, M- Male

Table 3. Test for differences in finger ridge counts of all fingers of Igbo and Okrika subjects

Hypothesis Test Summary				
	Null Hypothesis	Test	Significance	Decision
1.	The distribution of right Thumb is the same across categories of Tribe (sex)	Independent- samples Kruskal –Wallis Test	0.876	Retain the null hypothesis
2.	The distribution of right index finger is the same across categories of Tribe (sex)	Independent- samples Kruskal –Wallis Test	0.564	Retain the null hypothesis
3.	The distribution of right middle finger is the same across categories of Tribe (sex)	Independent- samples Kruskal –Wallis Test	0.231	Retain the null hypothesis
4.	The distribution of right ring finger is the same across categories of Tribe (sex)	Independent- samples Kruskal –Wallis Test	0.008	Reject the null hypothesis
5.	The distribution of right little finger is the same across categories of Tribe (sex)	Independent- samples Kruskal –Wallis Test	0.379	Retain the null hypothesis
6.	The distribution of left thumb is the same across categories of Tribe (sex)	Independent- samples Kruskal –Wallis Test	0.915	Retain the null hypothesis
7.	The distribution of left index finger is the same across categories of Tribe (sex)	Independent- samples Kruskal –Wallis Test	0.426	Retain the null hypothesis
8.	The distribution of left middle finger is the same across categories of Tribe (sex)	Independent- samples Kruskal –Wallis Test	0.954	Retain the null hypothesis
9.	The distribution of left ring finger is the same across categories of Tribe (sex)	Independent- samples Kruskal –Wallis Test	0.196	Retain the null hypothesis
10.	The distribution of left little finger is the same across categories of Tribe (sex)	Independent- samples Kruskal –Wallis Test	0.036	Reject the null hypothesis

The significance level is 0.05

Table 4. Descriptive Statistics of ADT angle for the right and left hand of Igbo and Okrika Subjects

Subjects	Right ADT (°) Angle			Left ADT (°) Angle		
	N	Mean	Standard Deviation (±)	N	Mean	Standard Deviation (±)
Igbo male	51	77.41	5.174	51	78.33	4.306
Igbo female	49	77.67	5.068	49	78.36	3.580
Okrika male	49	78.63	3.817	49	79.85	3.813
Okrika female	51	78.76	3.542	51	79.92	3.764

Table 5. Test for Differences in the Mean of ADT of the right and left hand of Igbo and Okrika subjects

Hypothesis Test Summary				
	Null Hypothesis	Test	Significance	Decision
1.	The distribution of right ADT angle is the same across categories of Tribe (sex)	Independent - samples Kruskal –Wallis Test	0.565	Retain the null hypothesis
2.	The distribution of left ADT angle is the same across categories of Tribe (sex)	Independent - samples Kruskal –Wallis Test	0.087	Retain the null hypothesis

The significance level is 0.05

significant differences between the distribution of Right ring finger and Left little finger of Igbo and Okrika subjects ($P < 0.05$). In table 4 Igbo males on the right hand had the mean ADT angle of 77.41 ± 5.174 , left hand 78.33 ± 4.306 ; Igbo females on the right hand had the mean ADT angle of 77.67 ± 5.068 , left hand 78.36 ± 3.580 whereas the Okrika males on the right hand had the mean ADT angle of 78.63 ± 3.817 , left hand 79.85 ± 3.813 and the Okrika females on the right hand had the mean ADT angle of 78.76 ± 3.542 , left hand 79.92 ± 3.764 .

DISCUSSION

Finger Ridge Count is a strong tool in identification of individuals as result its rarity and uniqueness. However, it takes a certain pattern which could be most common with a people, tribe or nation at large. The result of this study showed explicitly sexual dimorphism in the distribution of the ridges amongst the Igbos where the males had higher distributions than the female subjects consistently. This appears to have happened as result hormonal interplay in the development of the ridges in-utero and could serve as a strong marker for gender identification where the sexes of the prints or ridges are unknown. Although this finding negates the results of these authors (Oladipo *et al.*, 2013; Anibor *et al.*, 2011; Oladipo

et al., 2010; Ekanem *et al.*, 2009; Jaja and Igbigbi 2008; Osunwoke *et al.*, 2008; Sharma *et al.*, 2008; Oladipo *et al.*, 2007; Oladipo and Akanigha 2005; Igbigbi and Msamati 2005; Oladipo and Ogunnowo 2004; Igbigbi and Msamati 2002; 2001; Babler 1989; Oguranti and Sorgia 1984; Borroffice 1978) in previous their previous works where they maintained that there was gender difference in the populations studied. Another striking feature revealed in this study amongst the Igbos was handedness. The Igbo population consistently had a higher ridge distribution on the right hand than the left hand meaning that one could tell the right hand from the left where it was not established by merely doing ridge count and noting the hand that had highest count as the right and the other as left hand with lesser ridge count. This further suggests that there could be a relationship between handedness and ridge distribution though handedness was not investigated in this very study. In the Okrika population, sexual dimorphism was not prominent as was seen in the Igbo population which means that the hormonal interference noted in the Igbo population did not occur in the Okrikas' which further suggests that the sexual dimorphism could be a trait or phenomenon peculiar to certain tribes or people probably a result of the environmental and geographical factors at play. Handedness was prominent in the Okrika population except for the thumb where they were more distributed on the left thumb than the right thumb in the females which is different from the distribution seen in the

Igbos. The male population of the Okrikas' also showed handedness in the distribution of ridges except for the middle fingers where they were more distributed on the left than the right hand. It would be worth mentioning that these exceptions in the distribution of ridges on the thumb and the middle fingers may have occurred by chance.

On comparison of the finger ridge count, it was observed that there was a significant difference between the distribution of right ring finger and the left little finger in both ethnic groups. The statistical significance seen the right ring finger further strengthens the notion about handedness and distribution of ridges in which the right hands had higher distribution consistently. Although there was a statistical significant difference on the left little finger as well, it could only be attributed to have occurred by chance since it was not consistent. It suggests that both tribes are distinct and unique in their genetic makeup as such unrelated by any means in their ancestry and this result agrees with the one obtained by these authors (Oladipo et al., 2013; Anibor et al., 2011; Oladipo et al., 2010; Ekanem et al., 2009; Jaja and Igbigbi 2008; Osunwoke et al., 2008; Sharma et al., 2008; Oladipo et al., 2007; Oladipo and Akanigha 2005; Igbigbi and Msamati 2005; Oladipo and Ogunnowo 2004) in their previous reports. Generally, on comparison the Igbos had higher mean ridge count in the ridge distribution than Okrikas which may be attributed to the difference in genetic make-up of both tribes. The ADT angles revealed that the Okrikas' had higher values than the Igbos consistently in both sexes which could be explained to be a result of difference in the genetic make-up of both tribes. The result of the study also indicated a trend in the ADT angles where the values for the left hand were consistently higher than the right hand for both tribes and in both sexes. It therefore implies that this trend could be used to differentiate the left from the right hands in forensic studies especially where the sexes were not established ab initio. The test of significance for the ADT angles in both tribes showed no significant difference at the significance level of 0.05.

Conclusion

In conclusion this study has been able to establish handedness in the distribution of finger ridge counts amongst the Igbos' and Okrikas' in Southern Nigeria. Have shown that sexual dimorphism in ridge distribution could be a trait peculiar to certain tribes, also a trend in the ADT angular dimensions of the hand that could serve as a useful tool in determining handedness. Finally the study revealed that both tribes are distinct and unique in their genetic makeup as such are unrelated by any means in their ancestry and the little similarity in the ridge distribution could only have occurred by chance.

REFERENCES

- Abue A. D., Didia B. C. 2013. Loop Dermatoglyphics Patterns on the Plantar surface of the Sole in Hausa Ethnic Group of Nigeria. *Journal of Scientific and Innovative Research*, 2(3): 525-528.
- Adebisi S. S. 2009. The Recent Challenges and Advancements. A literary review. *Journal of Biological Anthropology*, 2(2): 16-24.
- Anibor E., Eboh D.E.O., Okumagba M.T., and Etetafia M.O. 2011. Palmar and digital dermatoglyphic patterns of the Ijaws in Delta state of Nigeria. *Arch. Appl. Sci. Res.*, 3(6):301-306.
- Aronson J. 1997. When I use a word Fingerprints. *British Medical Journal*; 315(7113): 10.
- Babler, W. J. 1989. Prenatal development of dermatoglyphic patterns: Association with epidermal ridge, volar pad and bone morphology. *Cell Antropol.*, 11:297-304.
- Babler, W. J. 1991. Embryogenic development of epidermal ridges and their configurations. In: Plato, C., Garruto, R. and Schaumann, B. (Eds). *Dermatoglyphics: Science in Transition*. Wiley-Liss, Inc. 95-112.
- Bali R. S. 1968. Genetic Inter correlation between finger and toe prints Z. *Morph. Anthropology*, 59:369-372.
- Bonnevie, K. 1924. Studies on palillary patterns of human fingers. *Journal of Genetics*, 15:1-111.
- Boroffice R. A. 1978. Digital dermatoglyphic patterns in a sample of the Nigerian population. *Am J Phy Anthropology*, 49(2): 167-70.
- Campbell, E. D. 1998. *The Encyclopedia of Palmistry*. A Perigee Book, Berkley Publishing Group, New York. Pp. 98-124.
- Cannon M, Byrne M, Cotter D, Sham P, Larkin C, O'Callaghan E. 1994. Further evidence for anomalies in the hand-prints of patients with schizophrenia: A study of secondary creases. *Schizophr Res.*, 13(2):179-84
- Cochran, W. G. 1963. *Sampling Techniques*, 2nd Edition. New York: John Wiley and Sons, Inc. Pp2-5.
- Cummins H, Midlo C. 1926. Palmar and plantar epidermalridge configurations in European Americans. *Amer J PhysAnthrop.*, 9: 471-502.
- Cummins H, Midlo C 1961. *Finger Prints, Palms and Soles*. New York: Blackiston.
- Cummins, H. 1929. The topographic history of the volar pads (walking pads: Tastballen) in the human embryo. *Contrib. Embryology*, 113(20):105-126
- Ekanem, E. P., Eluwa, M. A., Udoaffah, G. U., Ekanem, T. B. And Akpantah, A. O. 2009. Digital Dermatoglyphic Patterns of Annang Ethnic Group in Akwalbom Nigerian. *The Internet Journal of Biological Anthropology*, Vol. 3, Number 1. DOI: 10.5580/2645. ISSN: 1939-4594.
- Harich N, Esteban E, chafik A, Moral P. 2002. Dermatologic characterization of berbers from morocco: Qualitative and quantitative digital and palm data. *Ann. Hum. Biol.*, 29(4): 442-456.
- Hirsch W. 1978. Dermatoglyphics and Crease in their relationship to clinical syndrome. A Diagnostic Criterion Mauton Publisher. The Hague/Paris Pp 263-289, 275-283.
- Hirsch W, Schweichel J.U. 1973. Morphological Evidence Concerning the problem of skin ridge formation. *J. MentDefic Res.*, 17:58-72.
- Holt S.B. 1975. Dermatoglyphic Pattern Human Variability and Natural Selection. Symposia of the Society for study of *Human Biology*, 13:159-178.
- Humphrey, T. 1964. Some correlations between the appearance of human fetal reflexes and the development of the nervous system. *Prog Brain Res.*, 4:93-135.
- Igbigbi P. S. and Msamati B. C. 2001. Palmar and digital dermatoglyphic characteristics of Zimbabwean subjects. *East Afr Med J.*, 78(10): 536-539.
- Igbigbi PS, Msamati BC. 1999. Palmar and digital dermatoglyphic patterns in Malawian subjects. *East African Med J.*, 76(12):668-71.
- Igbigbi PS, Msamati BC. 2002. Palmar and digital dermatoglyphics of indigenous black Zimbabweans. *Med SciMonit.*, 8(11):CR757-61.

- Igbigbi PS, Msamati BC. 2005. Palmar and digital dermatoglyphic traits of Kenyan and Tanzanian. *West Africa Journal of Medicine*, 24(1): 26-30.
- Jaja BN, Igbigbi, PS. 2008. Digital and palmar dermatoglyphics of the Ijaw of Southern Nigeria. *African J Med Sci.*, Mar;37(1):1-5.
- Kusuma Y.S, Babu B.V, Naidu J.M. 2002. Finger ridge correlations among four tribes of Andra Pradesh, India. *Coll. Anthropol.*, 26 (1): 319-323.
- Loesch, DZ; Lafranchi, M; Ruffolo, C. 1990. Hand locomotor functions, body structure, and epidermal ridge patterns: preliminary study. *Hum Biol.*, 62:665-679.
- Martin, NG; Eaves, LJ; Loesch, DZ. 1982. A genetical analysis of co-variation between finger ridge counts. *Ant Hum Biol.*, 9:539-552.
- Mulvihill J.J., Smith D.W. 1969. The genesis of dermatoglyphics. *Journal of Pediatrics*, 75:579-589.
- Oguranti and Sorgia, 1984. Dermatoglyphics study of southern Nigerian population of Ogoni people of River State. *Journal of Experimental and Clinical Anatomy*, 12-16.
- Oladipo G. S., Afolabi E. O., Esomonu C. 2010. Dermatoglyphic patterns of Obese versus Normal weight Nigerian individuals. *Biomedicine International*, 1:66-69.
- Oladipo G. S., Akanigha E.B. 2005. Dermatoglyphic patterns in Androgenic Alopecia in a South Eastern Nigeria population. *J. Exp. Clin. Anat.*, 4(2):44-47.
- Oladipo G. S., Ogunnowo B. M. 2004. Dermatoglyphic patterns in Diabetes Mellitus in a South Eastern Nigeria Population. *Afri. J. Appl. Zool. Environ Biol.*, 6:6-8.
- Oladipo G. S., Okoh P.D., Oghenemavwe L.E., Yorkum L.K. 2013. Dermatoglyphic Patterns of Autistic Children in Nigeria. *Journal of Biology, Agricultural and Healthcare*, 3(7):80-83.
- Oladipo G. S., Olotu E.j., Fawehinmi H.B., Okoh P.D., Iboroma A.D. 2007. Dermatoglyphics in Idiopathic (primary) dilated cardiomyopathy in South Southern Nigeria. *Scientific Research and Essay*, 2(10):416-420.
- Oladipo G.S., Dike E. U., Okoh P. D. 2012. A comparative study of the digital pattern, Position of Triradii, b-c, and a-d Palmar Distances of Diabetic subjects and Essential Hypertensive Individuals in Rivers State. *International Journal of Advanced Biotechnology and Research*, 3(2): 615-620.
- Osunwoke E. A., Ordu K. S., Hart J., Esomonu C., Tamunokuro F. B. 2008. A Study on the Dermatoglyphic Patterns of Okrika and Ikwerre Ethnic Groups of Nigeria. *Scientia Africana*, 7(2):143-147.
- Penrose L. S. 1967. Effect of Sex Chromosome on Some Characteristics of Dermal Ridges on Palms and Soles. *Lancet*, 13:298-300.
- Penrose L. S. 1968. Memorandum on dermatoglyphic nomenclature. *Birth Defects. Original Article Series*, 4 (3): 1-13.
- Penrose LS. 1984. Memorandum on dermatoglyphic. *Isr J Med. Sci.*, 20: 622-4.
- Popich G.A., Smith D.W. 1970. The genesis and significance of digital and palmar hand creases: Preliminary report. *J Pediatr.*, 77:1017-1023.
- Rathee R, Kamal N, Kumar A, Vashist M, Yadav R. 2014. Dermatoglyphic Patterns of Acute Leukemia Patients. *Int Res J Biological Sci.*, 3:90-93.
- Reddy GG. 1975. Finger dermatoglyphics of the Bagathas of Araku Valley (A. P.), India. *Am J PhysAnthropol.*, 42(2):225-8.
- Reed, T., Meier, R. 1990. Taking dermatoglyphic prints – a self instruction manual. Sponsored by the American Association of Dermatoglyphics.
- Roberts D.F., Chavez J. and Court S.D.M. 1970. The genetic component in child mortality. *Arch. Dis. Child.*, 45: 33-38.
- Sakineh A, Einollahi N, Dashti N, Vaez-Zadeh F. 2006. Study of dermatoglyphic patterns of hands in women with breast cancer. *Pak J Med Sci.*, 22(1):18-22
- Schaumann, B. and Alter, M. 1976. The genesis of dermatoglyphic disorders. New York springer verlag, berlin. 27-87.
- Seema M.A., Gandhi D., Singh M. 2012. Dermatoglyphics- Study and Review of Literature. *Novel Science International Journal of Medical Science*, 1(6):191-198.
- Sharma P.R, Gautama A.K, Tiwari P.K. 2008. Dermatoglyphic variations in five ethno – geographical cohorts of Indian populations: *The Internet Journal of Biological Anthropology*, 2(1).
- Tewari R. K. and Ravikumar K. V. 2000. History and development of forensic science in India. *J. Postgrad Med.*, 46:303-308.
- Udoaka, A.I. and Udoaka, E.G. 2009. Digital dermatoglyphics in Ijaw students of University of Port Harcourt, Nigeria. *Continental J. Biomedical Sciences*, 3:1-5.
- Zahra G., Nasser Mahdavi S and Saeedeh K. A. 2012. Quantitative and Qualitative Study of Dermatoglyphic Patterns in Albinism. *Current Research Journal of Biological Sciences*, 4(4):385-388.
