

Original Article

INHERITANCE PATTERN OF LIP PRINTS AMONG NIGERIANS

Omuruka T.C., Ordu K.S., Paul C.W., Ibeachu, P.C., Paul, J.N.

Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, University of Port Harcourt, Rivers State, Nigeria.

ABSTRACT

Introduction: Lip prints are normal wrinkles and grooves running between the inner labial mucosa and the outer skin of lips. The probability of an offspring inheriting certain traits from parents could be easily appreciated and predicted if the inheritance pattern is established. **Aim:** This study was aimed at investigating the inheritance pattern lip prints among Nigerians. **Methods:** A total of 450 subjects comprising of 150 families (father, mother and a child) were conveniently sampled from across Rivers State. Oghenemavwe and Osaat digital fingerprint capture technique were adopted for this study. The lips (upper and lower) were then divided lip into four quadrants (URQ, ULQ, LRQ, LLQ) to independently access and observe the predominant lip print patterns in each quadrant using Suzuki and Tsuchihashi's classification (Types; I, I', II, III, IV, and V). Using XLSTAT Statistical package (Addinsoft Version 2015.4.01.21575) Chi-square analysis was used to determine the association. $P < 0.05$ (at 95% confidence level) was taken to be significant. Lip prints of the parents (as a single group) were tabulated and their possible combination outcome (by crosses) in their offspring was established using Excel sheet. **Results:** The total distribution of lip prints between parents and offspring showed [Type I (Parents 315, 26.3%; Offspring 133, 22.2%), Type I' (Parents 210, 17.5%; Offspring 105, 17.5%), Type II (Parents 290, 24.2%; Offspring 131, 21.8%), Type III (Parents 191, 15.9%; Offspring 131, 21.8%), Type IV (Parents 186, 15.5%; Offspring 87, 14.5%), Type V (Parents 8, 0.7%; Offspring 13, 2.2%)] which had significant association ($P = 0.002$). Observation of the inheritance pattern of lip prints revealed almost impracticable predictability. **Conclusion** This study suggests that the inheritance pattern of lip prints were inconsistent with Mendelian fashion (dominant-recessive) rather, lip prints exhibit polygenic inheritance pattern with incomplete penetrance (reduced penetrance).

Keywords: Inheritance pattern, Mendelian fashion, Polygenetic, Incomplete penetrance, Lip prints, Nigerian

Corresponding author Email: chikwuogwo.paul@uniport.edu.ng

Lip prints as defined by Saraswathi et al. (2009) are normal surface slits, wrinkles and grooves generally referred to as sulci labiorum noticeable on the lips and formed between the inner labial mucosa and the outer skin. The examination of these features is called cheiloscopy (Augustine et al., 2008). According to Vats et al. (2012) and Prabhu et al. (2012), cheiloscopy or Quiloscopy also includes the study and application of lip prints. Lip prints have been reported by researchers to be unique to individual and could be used as a means of identification (Gondivkar et al., 2009; Eldomiaty et al., 2010; Edibamode et al., 2013; Obik et al., 2014). Interestingly Kumar et al. (2012), Nagrale et al. (2014), Shah et al. (2015) and Nagpal et al. (2015) have all opined that lip prints could be used for forensic purposes thus suggesting that it could be an adjunct for fingerprints in crime investigation.

Understanding inheritance patterns enable geneticists to predict the probability of an offspring inheriting certain traits from parents (Ordu et al., 2014; 2016), and Louis et al. (2012) explained that the manner and pattern in which gene is passed to offspring to produce traits bring about; single gene inheritance, sex-linked inheritance, multi-factorial or polygenic inheritance, mitochondrial inheritance.

Available literature shows that studies have been a focus on the distribution and disease association of lip prints, but its inheritance pattern and penetrability/expressivity is investigated studied and debated by researchers.

This research was therefore undertaken to investigate the inheritance pattern of lip prints among Nigerians.

MATERIALS AND METHODS

Study Sample

In this cross-sectional study 450 subjects comprising of 150 families (father, mother and a

child) of which 212 (47%) and 238 (53%) were males and females respectively were used for this study. As a family-based study 200 families were conveniently sampled from across Rivers State (due to the paucity of literature on complete family size and number within the study area) and subsequently, 150 families were selected (without consideration to ethnicity) to ensure randomization using sequence generated method.

Criteria for Subject Selection

Subjects selected for this study had no form of anatomical abnormality of the lip, were between the ages of ten (10) and sixty (60), were Nigerian by birth, and each family had at least an offspring (not adopted).

Methods of Data Collection

Lip prints were obtained (in a relaxed and closed position of the lip as to get a clearer and well-defined imprint) using Oghenamavwe and Osaat (2015)[16] digital print capture for dermatoglyphic patterns. In adopting and importing their method it was discovered for the first time that lip print patterns could also be captured using digital tools (like theirs) rather than the conventional red coloured lipstick, white A3 sized paper and magnifying lens.

By this method, Hp G3110 Photo scanner was used to capture the lips. The scanner was powered using 500watt solar power inverter connected to the 12volts rechargeable battery. The lips were magnified using the zooming tool on Hp laptop connected to the scanner via USB cords and then into four quadrants; upper right quadrant (URQ), upper left quadrant (ULQ), lower right quadrant (LRQ) and lower left quadrant (LLQ). Each quadrant was independently accessed for the predominant lip print patterns using Suzuki and Tsuchihashi's classification (Types; I, I', II, III, IV, and V).

Methods of Data Analysis

Generally, statistical analysis was performed using XLSTAT (Addinsoft Version 2015.4.01.21575). Chi-square analysis was used to determine association and trend of the trait (confidence level at 95%) between parents and offspring. Using Excel sheet the lip prints of the parents (as a single group) were tabulated and their possible combination outcome (by crosses) in their offspring were established.

RESULTS

Table 1a: Lip prints distribution/combination patterns in parents and inheritance (combination outcome) in offspring in the upper right quadrant (URQ)

Lip print Combination in parents	Inheritance pattern(combination outcome) in Offspring					
	Type I (%)	Type I' (%)	Type II (%)	Type III (%)	Type IV (%)	Type V (%)
Both parents type I	0 (0.0)	1 (50.0)	0 (0.0)	0 (0.0)	1 (50.0)	-
Father type I and Mother type I'	2 (40.00)	2 (40.00)	0 (0.0)	0 (0.0)	1 (20.0)	-
Father type I and Mother type II	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)	-
Father type I and Mother type III	1 (20.0)	1 (20.0)	3 (60.0)	0 (0.0)	0 (0.0)	-
Father type I and Mother type IV	4 (36.4)	1 (9.1)	0 (0.0)	1 (9.1)	5 (45.5)	-
Father type I' and mother type I	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)
Both parents type I'	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Father type I' and mother type II	0 (0.0)	1 (20.0)	3 (60.0)	0 (0.0)	0 (0.0)	1 (20.0)
Father type I' and mother type III	1 (16.7)	1 (16.7)	1 (16.7)	1 (16.7)	2 (33.3)	0 (0.0)
Father type I' and mother type IV	1 (14.3)	1 (14.3)	2 (28.6)	0 (0.0)	3 (42.9)	0 (0.0)
Father type II and mother type I	3 (60.0)	0 (0.0)	1 (20.0)	1 (20.0)	0 (0.0)	-
Father type II and mother type I'	0 (0.0)	1 (16.7)	2 (33.3)	1 (16.7)	2 (33.3)	-
Both parents type II	0 (0.0)	1 (16.7)	2 (33.3)	0 (0.0)	3 (50.0)	-
Father type II and mother type III	1 (11.1)	2 (22.2)	2 (33.3)	1 (11.1)	2 (22.2)	-
Father type II and mother type IV	1 (25.0)	0 (0.0)	1 (25.0)	0 (0.0)	2 (50.0)	-
Father type III and mother type I	0 (0.0)	0 (0.0)	1 (50.0)	0 (0.0)	1 (50.0)	0 (0.0)
Father type III and mother type I'	1 (10.0)	4 (40.0)	2 (20.0)	3 (30.0)	0 (0.0)	0 (0.0)
Father type III and mother type II	0 (0.0)	2 (22.2)	4 (44.4)	1 (11.1)	1 (11.1)	1 (11.1)
Both parents type III	1 (5.6)	2 (11.1)	2 (11.1)	9 (50.0)	4 (22.2)	0 (0.0)
Father type III and mother type IV	3 (27.3)	0 (0.0)	2 (18.2)	3 (27.3)	2 (18.2)	1 (9.1)
Father type IV and mother type I	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (100.0)	0 (0.0)
Father type IV and mother type I'	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)
Father type IV and mother type II	2 (33.3)	2 (33.3)	0 (0.0)	1 (16.7)	1 (16.7)	0 (0.0)
Father type IV and mother type III	0 (0.0)	0 (0.0)	0 (0.0)	3 (50.0)	2 (33.3)	1 (16.7)
Father type IV and mother type IV	2 (28.6)	0 (0.0)	2 (28.6)	1 (14.3)	2 (28.6)	0 (0.0)
Father type V and mother type III	-	-	-	-	-	1 (100.0)



Figure 1: Zoomed captured image of the lip, partitioned into quadrants to access the predominant lip print patterns using Suzuki and Tsuchihashi classification.

Table 1b: Lip prints distribution (in terms of percentage inheritance) and test of association on the Upper Right Quadrant (URQ) of Parents and Offspring

Family members	Upper right quadrant						Chi-square test		
	Type I	Type I'	Type II	Type III	Type IV	Type V	df	χ ²	P-value
Parents	38 (12.7)	43 (14.3)	58 (19.3)	95 (31.7)	63 (21.0)	3 (1.0)	5	12.2	0.03*
Offspring	23 (15.3)	23 (15.3)	33 (22.0)	28 (18.7)	37 (24.7)	6 (4.0)			
Total	61 (13.6)	66 (14.7)	91 (20.2)	123 (27.3)	100 (22.2)	9 (2.0)			

*= significant at P < 0.05

Table 2a: Lip prints distribution/combination patterns in parents and inheritance (combination outcome) in offspring in the upper left quadrant (ULQ)

Lip print Combination in parents	Inheritance pattern(combination outcome) in Offspring					
	Type I	Type I'	Type II	Type III	Type IV	Type V
Both parents type I	0 (0.0)	1 (33.3)	0 (0.0)	0 (0.0)	2 (66.7)	-
Father type I and Mother type I'	2 (50.0)	1 (25.0)	0 (0.0)	0 (0.0)	1 (25.0)	-
Father type I and Mother type II	1 (20.0)	1 (20.0)	2 (40.0)	1 (20.0)	0 (0.0)	-
Father type I and Mother type III	2 (50.0)	0 (0.0)	2 (50.0)	0 (0.0)	0 (0.0)	-
Father type I and Mother type IV	5 (45.5)	0 (0.0)	0 (0.0)	1 (9.1)	5 (45.5)	-
Father type I' and mother type I	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)
Father type I' and mother type II	1 (16.7)	1 (16.7)	3 (50.0)	0 (0.0)	0 (0.0)	1 (16.7)
Father type I' and mother type III	1 (14.3)	1 (14.3)	1 (14.3)	2 (28.6)	2 (28.6)	0 (0.0)
Father type I' and mother type IV	0 (0.0)	1 (20.0)	2 (40.0)	0 (0.0)	2 (40.0)	0 (0.0)
Father type II and mother type I	2 (50.0)	0 (0.0)	1 (25.0)	1 (25.0)	0 (0.0)	-
Father type II and mother type I'	0 (0.0)	1 (14.3)	3 (42.9)	1 (14.3)	2 (28.6)	-
Both parents type II	0 (0.0)	1 (20.0)	2 (40.0)	0 (0.0)	2 (40.0)	-
Father type II and mother type III	1 (9.1)	2 (18.2)	6 (54.5)	0 (0.0)	2 (18.2)	-
Father type II and mother type IV	1 (25.0)	0 (0.0)	1 (25.0)	2 (50.0)	0 (0.0)	-
Father type III and mother type I	0 (0.0)	0 (0.0)	1 (33.3)	1 (33.3)	1 (33.3)	0 (0.0)
Father type III and mother type I'	1 (11.1)	4 (44.4)	2 (22.2)	2 (22.2)	0 (0.0)	0 (0.0)
Father type III and mother type II	1 (10.0)	0 (0.0)	4 (40.0)	4 (40.0)	1 (10.0)	0 (0.0)
Both parents type III	0 (0.0)	1 (7.1)	3 (21.4)	6 (42.9)	4 (28.6)	0 (0.0)
Father type III and mother type IV	4 (36.4)	0 (0.0)	2 (18.2)	3 (27.3)	1 (9.1)	1 (9.1)
Father type IV and mother type I	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (100.0)	0 (0.0)
Father type IV and mother type II)	2 (25.0)	2 (25.0)	0 (0.0)	1 (12.5)	1 (12.5)	2 (25.0)
Father type IV and mother type III	0 (0.0)	0 (0.0)	0 (0.0)	3 (42.9)	2 (28.6)	2 (28.6)
Father type IV and mother type IV	2 (28.6)	0 (0.0)	1 (14.3)	1 (14.3)	3 (42.9)	0 (0.0)

Table 2b: Lip prints distribution (in terms of percentage inheritance) and test of association on the Upper Left Quadrant (ULQ) of Parents and Offspring

Family members	Upper left quadrant						Chi-square test		
	Type I	Type I'	Type II	Type III	Type IV	Type V	df	X ²	P-value
Parents	42 (14.0)	39 (13.0)	65 (21.7)	90 (30.0)	64 (21.3)	0 (0.0)	5	17.13	0.004*
Offspring	26 (17.3)	17 (11.3)	36 (24.0)	30 (20.0)	35 (23.3)	6 (4.0)			
Total	68 (15.1)	56 (12.4)	101 (22.4)	120 (26.7)	99 (22.0)	6 (1.3)			

*= significant at P < 0.05

Table 3a: Lip prints distribution/combination patterns in parents and inheritance (combination outcome) in offspring in the lower right quadrant (LRQ)

Lip print Combination in parents	Inheritance pattern(combination outcome) in Offspring					
	Type I	Type I'	Type II	Type III	Type IV	Type V
Both parents type I	11 (52.4)	4 (19.0)	2 (9.5)	1 (4.8)	3 (14.3)	-
Father type I and Mother type I'	1 (50.0)	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	-
Father type I and Mother type II	7 (46.7)	3 (20.0)	4 (26.7)	0 (0.0)	1 (6.7)	-
Father type I and Mother type III	6 (75.0)	1 (12.5)	0 (0.0)	1 (12.5)	0 (0.0)	-
Father type I and Mother type IV	2 (33.3)	1 (16.7)	1 (16.7)	0 (0.0)	2 (33.3)	-
Father has type I' and mother type I	3 (42.9)	4 (57.1)	0 (0.0)	-	-	-
Both parents type I'	4 (30.8)	8 (61.5)	1 (7.7)	-	-	-
Father has type I' and mother type II	0 (0.0)	2 (66.7)	1 (33.3)	-	-	-
Father type I' and mother type III	1 (50.0)	1 (50.0)	0 (0.0)	-	-	-
Father type I' and mother type IV	2 (100.0)	0 (0.0)	0 (0.0)	-	-	-
Father has type I' and mother type V	0 (0.0)	1 (100.0)	0 (0.0)	-	-	-
Father type II and mother type I	6 (37.5)	6 (37.5)	3 (18.8)	0 (0.0)	1 (6.3)	-
Father type II and mother type I'	0 (0.0)	2 (40.0)	2 (40.0)	1 (20.0)	0 (0.0)	-
Both parents type II	2 (13.3)	3 (20.0)	8 (53.3)	2 (13.3)	0 (0.0)	-
Father type II and mother type III	0 (0.0)	1 (33.3)	0 (0.0)	2 (66.7)	0 (0.0)	-
Father type III and mother type I	1 (25.0)	1 (25.0)	0 (0.0)	2 (50.0)	0 (0.0)	-
Father type III and mother type I'	1 (33.3)	0 (0.0)	2 (66.7)	0 (0.0)	0 (0.0)	-
Father type III and mother type II	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	-
Father type III and mother type IV	2 (28.6)	2 (28.6)	1 (14.3)	0 (0.0)	2 (28.6)	-
Father type IV and mother type I	2 (50.0)	0 (0.0)	0 (0.0)	1 (25.0)	1 (25.0)	-
Father type IV and mother type I'	0 (0.0)	3 (75.0)	0 (0.0)	0 (0.0)	1 (25.0)	-
Father type IV and mother type II	0 (0.0)	0 (0.0)	1 (33.3)	1 (33.3)	1 (33.3)	-
Father type IV and mother type III	1 (50.0)	0 (0.0)	1 (50.0)	0 (0.0)	0 (0.0)	-
Father type IV and mother type IV	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	-
Father V and mother type I	1 (100.0)	-	-	-	-	0 (0.0)
Father type V and mother type III	0 (0.0)	-	-	-	-	1 (100.0)

Table 3b: Lip prints distribution (in terms of percentage inheritance) and test of association on the Lower Right Quadrant (LRQ) of Parents and Offspring

Family members	Lower right quadrant						df	X ²	P-value
	Type I	Type I'	Type II	Type III	Type IV	Type V			
Parents	105 (35.0)	55 (18.3)	76 (25.3)	31 (10.3)	30 (10.0)	3 (1.0)	5	9.57	0.09
Offspring	53 (35.3)	45 (30.0)	28 (18.7)	11 (7.3)	12 (8.0)	1 (0.7)			
Total	158 (35.1)	100 (22.2)	104 (23.1)	42 (23.1)	42 (9.3)	4 (0.9)			

Table 4a: Lip prints distribution/combination patterns in parents and inheritance (combination outcome) in offspring in the lower left quadrant (LLQ)

Lip print Combination in parents	Inheritance pattern (combination outcome) in Offspring				
	Type I	Type I'	Type II	Type III	Type IV
Both parents has type I	10 (47.6)	5 (23.8)	4 (19.0)	1 (4.8)	1 (4.8)
Father type I and Mother type I'	1 (20.0)	4 (80.0)	0 (0.0)	0 (0.0)	0 (0.0)
Father type I and Mother type II	9 (52.9)	3 (17.6)	4 (23.5)	0 (0.0)	1 (5.9)
Father type I and Mother type III	3 (42.9)	1 (14.3)	1 (14.3)	1 (14.3)	1 (14.3)
Father type I and Mother type IV	2 (40.0)	1 (20.0)	1 (20.0)	0 (0.0)	1 (20.0)
Father type I' and mother type I	3 (42.9)	4 (57.1)	0 (0.0)	-	-
Both parents type I'	6 (42.9)	7 (50.0)	1 (7.1)	-	-
Father type I' and mother type II	0 (0.0)	1 (50.0)	1 (50.0)	-	-
Father type I' and mother type III	1 (50.0)	1 (50.0)	0 (0.0)	-	-
Father type I' and mother type IV	2 (66.7)	1 (33.3)	0 (0.0)	-	-
Father type II and mother type I	7 (46.7)	2 (13.3)	5 (33.3)	0 (0.0)	1 (6.7)
Father type II and mother type I'	0 (0.0)	2 (33.3)	3 (50.0)	1 (16.7)	0 (0.0)
Both parents has II	5 (26.3)	2 (10.5)	10 (52.6)	2 (10.5)	0 (0.0)
Father type II and mother type III	0 (0.0)	0 (0.0)	2 (66.7)	1 (33.3)	0 (0.0)
Father type III and mother type I	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)
Father type III and mother type I'	1 (50.0)	0 (0.0)	0 (0.0)	1 (50.0)	0 (0.0)
Father type III and mother type II	0 (0.0)	1 (50.0)	0 (0.0)	0 (0.0)	1 (50.0)
Both parents has III	1 (50.0)	0 (0.0)	1 (50.0)	0 (0.0)	0 (0.0)
Father type III and mother type IV	1 (33.3)	1 (33.3)	1 (33.3)	0 (0.0)	0 (0.0)
Father type IV and mother type I	2 (40.0)	0 (0.0)	1 (20.0)	1 (20.0)	1 (20.0)
Father type IV and mother type I'	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
Father type IV and mother type II	0 (0.0)	0 (0.0)	1 (33.3)	1 (33.3)	1 (33.3)
Father type IV and mother type III	1 (33.3)	0 (0.0)	2 (66.7)	0 (0.0)	0 (0.0)
Father type V and mother type I	1 (100.0)	-	-	-	0 (0.0)
Father type V and mother type III	0 (0.0)	-	-	-	1 (100.0)

Table 4b: Lip prints distribution (in terms of percentage inheritance) and test of association on the Lower Left Quadrant (LLQ) of Parents and Offspring

Family members	Lower left quadrant						df	X ²	P-value
	Type I	Type I'	Type II	Type III	Type IV	Type V			
Parents	105 (35.0)	56 (18.7)	86 (28.7)	28 (9.3)	23 (7.7)	2 (0.7)	5	4.89	0.43
Offspring	56 (37.3)	37 (24.7)	39 (26.0)	9 (6.0)	9 (6.0)	0 (0.0)			
Total	161 (35.8)	93 (20.7)	125 (27.8)	37 (8.2)	32 (7.1)	2 (0.4)			

Table 5: Test of association in distribution of lip print patterns in Parents and Offspring

Family members	N		Lip print						X ²	P-value
			Type	Type	Type	Type	Type	Type		
			I	I'	II	III	IV	V		
Parents	300	Count	315	210	290	191	186	8	19.42	0.002*
	66.7	% within Family members	26.3	17.5	24.2	15.9	15.5	0.7		
Offspring	150	Count	133	105	131	131	87	13		
	33.3	% within Family members	22.2	17.5	21.8	21.8	14.5	2.2		
Total	450	Count	448	315	421	322	273	21		
	100	% within Family members	24.9	17.5	23.4	17.9	15.2	1.2		

*= significant at P < 0.0

Distribution and Association test of lip prints

As seen in Tables 1a, 2a, 3a, and 4a the inheritance of lip prints do not follow a clear predictable pattern. However, the distribution and test of association between the lip print patterns of parents and offspring in their URQ showed the following.

In table 1b, the distribution was thus Type I (12.7%) for parents and (15.3%) for offspring, Type I' (14.3%) for parents and (15.3%) for offspring, Type II (19.3%) for parents and (22.0%) for offspring, Type III (31.7%) for parents and (18.7%) for offspring, Type IV (21.0%) for parents and (24.7%) for offspring, Type V (1.0) for parents and (4.0%) for offspring. The distribution was significant (X² = 12.23, P = 0.03)

In table 2b, the ULQ had the distribution and association between parents and offspring: Type I (14.0%) for parents and (17.3%) for offspring, Type I' (13.0%) for parents and (11.3%) for offspring, Type II (21.7%) for parents and (24.0%) for offspring, Type III (30.7%) for parents and (20.0%) for offspring, Type IV (21.3%) for parents and (23.3%) for offspring, Type V (0.0) for parents and (4.0%) for offspring. The distribution was significant (X² = 17.13, P = 0.004).

In table 3b, the distribution of the lip print types in the LRQ of parents and offspring were presented as follows; Type I (35.0%) for parents and (35.3%) for offspring, Type I' (18.3%) for parents and (30.0%) for offspring, Type II (25.3%) for parents and (18.7%) for offspring, Type III (10.3%) for parents and (7.3%) for offspring, Type IV (10.0%) for parents and (8.0%) for offspring, Type V (1.0) for parents and (0.7%) for offspring; however, the

distribution was not significant ($X^2 = 9.75$, $P = 0.09$).

Table 4b showed Type I (35.0%) for parents and (37.3%) for offspring, Type I' (18.7%) for parents and (24.7%) for offspring, Type II (28.7%) for parents and (26.0%) for offspring, Type III (9.3%) for parents and (6.0%) for offspring, Type IV (7.7%) for parents and (6.0%) for offspring, type V (0.7) for parents and (0.0%) for offspring. The distribution was not significant ($X^2 = 4.89$, $P = 0.43$).

The total distribution of lip prints as seen in Table 5 [Type I (Parents 315, 26.3%; Offspring 133, 22.2%), Type I' (Parents 210, 17.5%; Offspring 105, 17.5%), Type II (Parents 290, 24.2%; Offspring 131, 21.8%), Type III (Parents 191, 15.9%; Offspring 131, 21.8%), Type IV (Parents 186, 15.5%; Offspring 87, 14.5%), Type V (Parents 8, 0.7%; Offspring 13, 2.2%)] revealed a significant association between parents and offspring ($X^2 = 19.42$, $P = 0.002$).

DISCUSSION

In bit to ascertain the percentage inheritance and association of lip prints between parents and offspring it was observed that in an ascending order there were Type III, IV, II, I', I, V and Type IV, II, III, I & I' (equal), V in the URQ of the parents and offspring respectively. Similarly, in the ULQ the order according to percentage inheritance of lip prints (from high to low) in the parents were Type III, II, IV, I, I' while that of offspring were Type II, IV, III, I, I, V. Lip print patterns were significantly distributed differently in parents and offspring in the URQ and ULQ. This shows that the percentage inheritance of lip prints in the upper lip (URQ and ULQ) of the offspring depend on that of the parents. This finding supports the position of Priyanka *et al.* (2013) who found a strong positive and significant correlation between parents and their offspring, indicating the role of heredity in lip prints. Narwal *et al.* (2014) found that lip prints followed a hereditary pattern in one quadrant out of all the quadrants studied. Rashmi *et al.* (2011) and George *et al.* (2016) also, suggested that there was a similarity in the distribution of the lip print patterns of the mother and the child in the third quadrant of the lower lip. On the other hand, in the LRQ and LLQ, there were (from highest to lowest percentage) Type I, II, I', III, IV, V in the parents whereas in the offspring the order were Type I, I', II, IV, III, V (in the LRQ) and Type I, II, I', III & IV

(equal), V. The percentage inheritance and association between parents and offspring in the LRQ and LLQ were not statistically significant suggesting that there was no relationship in the percentage inheritance of lip prints between parents and offspring in the LRQ and LLQ. Alternatively, this could imply that the distribution of lip prints in the lower lip part (LRQ and LLQ) of the offspring does not depend on that of the parents. Type III has the highest percentage resemblance, while the least was Type V. This did not also deviate from the study of Narwal *et al.* (2014) who reported that out of all the quadrants studied, most quadrants did not show any significant association and relationship between child and parents, but that there are resemblance lip prints between parents and offspring which suggests the influence of other factors other than genetic in its inheritance. However, in general, there was a statistically significant association between parents and offspring in the inheritance of lip prints.

Furthermore, using the various lip print types combination of parents (crossing the various lip print types of parents in a Table) in trying to establish the inheritance pattern of lip prints in the study population, the combination outcome revealed that some lip print types (combination) had combination outcome of high frequency when compared to others among the study population. In the URQ, there was no combination outcome of Type V when the father was Types I and II all through. Also, in the ULQ. There was also no combination outcome of Type V when the father was Types I and II all through. Similarly, in the LRQ Type I and Type I in parents produced offspring with mainly Type I and Type II, but there were no combination outcomes of Type III when the father was Type I' all through. Also, there were no combination outcomes of Type IV when the father was Type I' all through and Type V when the father was Type I, I', II, III and IV all through. The trend in the LLQ was no exception, as there were no combination outcomes of Type III and IV when the father was Type I' all through and Type V when the father was Type I, I', II, III, IV and V all through.

From keen observation of the Combination Outcome Tables (COTs), it could be deduced that inheritance pattern of lip prints do not follow the Dominant-Recessive pattern and as such is not a Mendelian trait. As a trait with multiple alleles, it did not also exhibit codominance as in the case of ABO blood group.

CONCLUSION

There was some level of similarities in the patterns of distribution of this trait particularly in the upper lip between the parents and the offspring, buttressing that lip prints are genetically determined. However, the study observed the influence of variant forms of the lip on the outcome in offspring. The Type I' lip print exhibited a variant form of Type I and Type III in some cases also exhibited a variant form of Type IV. This suggests that Type I' could be variant of Type I (vertical pattern) and Type III variant of Type IV (crossed pattern).

Findings from this study suggest that the inheritance pattern of lip prints were inconsistent with Mendelian fashion (dominant-recessive) thus, observed polygenic inheritance with incomplete penetrance (reduced penetrance) for the lip prints.

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