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Allelic Frequency of different morphometric traits among students of University of Ilorin, Ilorin, Nigeria

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ABSTRACT

Morphological traits are measurable characteristics of individual organism. These include aspects of the outward appearance (shape, structure, color, and pattern) as well as the form and structure of the internal parts like bones and organs. In this study, the occurrences of these traits among students of University of Ilorin, Ilorin, Nigeria were investigated. Ten (10) traits (Tongue rolling, widow's peak, chin cleft, dimple, free earlobe, Achoo syndrome, bent little finger, early onset myopia, hand clasping and hair phalanges) were selected and a retrospective study was carried out among 2000 students in nine (9) different faculties. The results were analyzed using Microsoft excel 2010, SPSS-version 21 and Hardy-Weinberg (H-W) equation. The H-W equation showed that the frequencies of recessive alleles (q) were higher than the dominant alleles in all the traits. Also, the homozygous dominant genotypes in all the traits except early onset myopia were less than the homozygous recessive and heterozygous genotypes. This study provides normative data for the distribution of the ten traits among the students of University of Ilorin.

Keywords: Morphometric traits, Allelic frequency, Genotypic frequency, Hardy-Weinberg equation

INTRODUCTION

A phenotypic trait is an obvious, observable and measurable trait that can be observed in an individual. It is the expression of genes in an observable way. Phenotypic traits are also observable characteristics determined by specific segments of DNA called genes. Multiple genes are grouped together to form chromosomes, which reside in the nucleus of the cell. Every cell (except eggs and sperms) in an individual's body contains two copies of each gene. This is due to the fact that both mother and father contribute a copy at the time of conception. This original genetic material is copied each time a cell divides so that all cells contain the same DNA. Genes store the information needed for the cell to assemble proteins, which eventually yield specific physical traits (Singh and Sengupta 2004). Although all aspects of the phenotype are controlled by the genetic make-up of the organism, at least to some extent, they are also influenced by the environmental conditions the organism is subjected to across its ontogenetic development including various epigenetic processes (Gilbert 2005; Monaghan, 2008). Regardless of the relative degree of genetic versus environmental control, the phenotype encompasses all the characteristics of an organism, including traits at multiple levels of biological organization, ranging from behavior and evolutionary history of life traits (e.g. litter size), through morphology (e.g. body height and composition), physiology (e.g. blood pressure), cellular characteristics (e.g. membrane lipid composition, mitochondrial densities), components of biochemical pathways, and even messenger RNA(Gingeras, 2007). Human population provides an exclusive opportunity to study the morphogenetic variation among the endogamous populations living in different geographical and ecological circumstances (Bhasin and Khanna 1993). Genetic variability is a common attribute of humans. The presence of genetic variation in man is controlled by many factors including assortment, migration, gene flow and genetic drift (Vogel and Motulsky 1986). Humans contain hereditary traits including both dominant and recessive (Jurmain *et al.*,2013). The tongue is a muscular organ used for verbal communication and tasting (Sokoloff and Deacon 1992). Tongue movement survey first time has been conducted by Sturtevant in 1940 (Sturtevant 1940). The inheritance of the ability to roll tongue sides meet at the top of the tube upwards to form a closed tube, is due to recessive gene and inability is due to a dominant gene (Liu and Hsu 1949) while the ability to fold lateral edges of the tongue in U shape is reported due to significant dominant gene and a recessive gene is responsible for its inability (Sturtevant 1940).

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Dimples are petite, appreciable indentations appear on the surface of the skin. It is inherited as dominate trait and may appear unilaterally or bilaterally in both sexes (Argamaso 1971 and Pentozos *et al.*, 2004). Anatomically double or bifid zygomaticus muscles are responsible for facial dimples (Gassner 2008 and Pessa *et al.*, 1998). In lower jaw, Y shaped cleft present result of an underlying bony defect that is due to incomplete fusion of left right lower jaw bone during embryonic development (Port 2007). Lebow and Sawin 1941) first suggested that cleft chin was a genetic character; single recessive gene is responsible for cleft chin and a dominant for smooth chin. The phenotypic traits include: tongue rolling or folding, widow's peak, chin cleft, dimple, free earlobe, Achoo syndrome (sneeze while exposed to sudden light), bent little finger, early onset myopia, hand clasping and hair phalanges and others observable traits have particular genes encoded in each of them (Singh and Sengupta, 2004; Port, 2007). The significance of morphogenetic traits genetic mechanism is still not clearly understood as it is seen to occur with erratic regularity in different populations and thus constructive in evaluating and analyzing evolutionary relation and classification as well (Das and Sengupta, 2003). Efforts to identify key genes influencing multi-factorial complex phenotypes such as many of the psychiatric disorders continue to be less than satisfactory (Inoue and Lupski, 2003; Van de Bree and Owen, 2003). On one hand, scientists are beginning to understand how genes interact with each other and with environmental factors in ways that impact on health (Xu *et al*., 2001) while on the other, there is a growing sense in genetic epidemiology that many findings are failing to replicate, because many of the claimed associations are false positive and these false positives are seen because of our inability to study many genetic variants in relation to many disease outcomes without knowing the precise bio-cultural background of the groups being studied (Cardon and Bell, 2001; Colhoun *et al.*, 2003). Thus, this study aimed to investigate ten different phenotypic traits that exist among students in University of Ilorin, Ilorin, Nigeria.

MATERIALS AND METHODS

Sampling Site

This study was carried out to determine the human phenotypic traits in University of Ilorin, Ilorin Nigeria. A total number of 2000 students were selected from different faculties in the University.

Sampling Procedure

A questionnaire was formulated based on 10 different phenotypic traits in human such as tongue rolling, widow's peak, dimple, chin cleft, Achoo syndrome (sneezing when suddenly exposed to light), hand clasping, hair phalanges, early onset myopia, free earlobe and bent little finger in relation to the faculty. The students were asked to fill the questionnaire individually. This study was conducted among the students of University of Ilorin between the ages of 15 and 30 years both male and female.

Statistical Analysis

The data obtained were arranged in tables, and graph on the basis of simple percentage. This study was analyzed using Microsoft Excel 2010 and SPSS statistical package version 21.0. Statistical package for Social Sciences (SPSS) version 21.0 for windows (Chicago, IL.USA) was used for 5% level of significance Chi square was used to calculate for the level of significance. Hardy-Weinberg (H-W) Equation was also used. p and q were assigned for frequency of dominant alleles and frequency of recessive alleles respectively, $p+q= 1$. p^2, $2pq$ and q^2 were assigned for frequency of individual dominant genotype, frequency of individual heterozygous genotype and frequency of individual recessive genotype respectively, $p^2+2pq+q^2=1$.

RESULTS

The phenotypic distribution of the ten (10) different types of morphogenetic traits amongst the students based on their faculties is shown in Table 1. From the table, it shows that for tongue rolling, the Faculty of Social Science has the highest number of student that can roll their tongue (63.4%) and the lowest was recorded among the students in Faculty of Law (46.6%). The highest was recorded for widow's peak in social sciences (51.9%) and the lowest was in Art (21.9%). Also, for chin cleft trait the highest was recorded in Social Science (48.1%) and the lowest was in Art (21.9%) while for dimple, the highest was observed among the students in the Faculty of Social Science (49.6%) and the lowest in Art (30.5%). The percentage frequency for free earlobe was highest in Faculty of Management Science (67.9%) and the lowest was recorded in Art (38.4%), whereas the Achoo Syndrome shows the highest percentage in Physical Sciences (26.2%) and the lowest was recorded in Life Sciences (6.9%). For Bent Little

Finger, the highest was observed in social science (37.7%) and the lowest in Art (27.8%). For Early Onset Myopia the highest was recorded in Faculty of Management Science (47.1%) and the lowest was observed in Faculty of Art (35.1%). For Hand Clasping, the highest was recorded in Faculty of Agriculture (53.7%) and the lowest was in Physical Science (37.5%) and for Hair Phalanges the highest was recorded in Faculty of Agriculture (80.8%) and the lowest was recorded in Physical Science (42.5%). Table 2 shows allelic frequency of ten (10) morphometric traits among the students of University of Ilorin, it shows the frequency of dominant alleles (p) and frequency of recessive alleles (q) for nine different Faculties. The result revealed that the frequencies of recessive alleles (q) were higher than the dominant alleles in all the traits. The genotypic frequency where the homozygous and/or heterozygous dominant/recessive of the ten traits were determined are shown in Table 3-5. From the tables, it can be deduced that homozygous dominant genotypes in all the traits except early onset myopia were less than the homozygous recessive and heterozygous genotypes.

DISCUSSION

According to the result, the prevalence of widow's peak was low in the sample population. This is in tandem with the work of Nwaopara *et al.,* (2008) where they reported that only 13% of the population sampled expressed widow's peak. However, Nusbaum and Fuentefria (2009) had a different report that 81% of the population had widow's peak. The reason for the variance may be due to migration or high variation in the population which might affect the gene pool or disagreement over what constitute a widow's peak by the researchers. Tongue rolling in the population was more expressed, as 58.8% of the sample population could roll their tongue. This is in agreement with the work of Nwaopara *et al*., (2008) where it was reported that 51.8% of individuals in the population could roll their tongue and 48.19% could n't. Also, this study does not agree with the work of Kooffreh *et al*., (2015) as only 48% of the population sampled could actually roll their tongue and 51% could not. This suggests that among the university of Ilorin students, tongue rolling is a dominant trait. For free ear lobe consideration in this study, the frequency of the trait was lower (46.6%) than those that have attached ear lobe (53.5%). This research work is not in agreement with Singh and Sengupta (2004) when they researched on the morphogenetic traits among the Assamese Sikhs and found out that 16.35% had attached ear lobe compared to 83.65% that had free ear lobe. This variance of result might be due to ethnic variation The result on hair phalanges shows that, 71% expressed the trait compared to the 29% that does not express the trait. This finding is in line with the work of Kooffreh *et al*., (2015) where it was found that 92% of the individuals sampled had hair phalanges while 8% did not. This research work is not in agreement with the work of Singh and Sengupta (2004) where it was reported that 55.77% did not have hair phalanges while 44.23% had. The report ofSingh (1987) that hair phalanges are common in Nigeria supports this study. In the sample population, 38.4% expressed dimple trait while 61.7% did not. This result is in line with the work of Kooffreh *et al.,* (2015) where it was found that 21.2% has dimple and 78.8% did not. We could infer that some traits co-inherited with the dimple traits (small face etc) could suppress the phenotypic expression of dimples. It might also be due to penetrance due to variation. The result of the chin cleft study showed a lower frequency in occurrence (30.5%). Enlow, (1982) suggested that chin cleft is a postnatal phenomenon, which is as a result of bone resorption near the alveolar margin, with concomitant deposition of bone more inferiorly. This suggests that chin cleft is not a heritable trait.

Table 1: Phenotypic Distribution of Ten (10) different Morphometric Traits Among Students of University Of Ilorin, Ilorin Nigeria.

FACULTY	N	TONGUE ROLLING		WIDOWS PEAK		CHIN CLEFT		DIMPLE		FREE EARLOBE		ACHOO SYNDROME		BENT LITTLE FINGER		EARLY ONSET MYOPIA		HAND CLASPING		HAIR PHALANGES	
		P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A
Agriculture	281	163 (58.0)	118 (42.0)	103 (36.7)	178 (63.3)	58 (20.6)	223 (79.4)	94 (33.5)	187 (66.5)	138 (49.1)	143 (50.9)	24 (8.5)	257 (91.5)	49 (17.4)	232 (82.6)	78 (27.8)	203 (72.2)	151 (53.7)	130 (46.3)	227 (80.8)	54 (19.2)
Art	151	92 (60.9)	59 (39.1)	60 (39.7)	91 (60.3)	33 (21.9)	118 78.1)	46 (30.5)	105 (69.5)	58 (38.4)	93 (61.6)	23 (15.2)	128 (84.8)	42 (27.8)	109 (72.2)	53 (35.1)	98 (64.9)	73 (48.3)	78 (51.7)	90 (59.6)	61 (40.4)
Education	187	115 (61.5)	72 (38.5)	85 (45.5)	102 (54.5)	57 (30.5)	130 (69.5)	73 (39.1)	114 (60.9)	69 (36.9)	118 (63.1)	29 (15.5)	158 (84.5)	78 (41.7)	109 (58.3)	91 (48.7)	96 (51.3)	123 (65.8)	64 (34.2)	133 (71.1)	54 (28.9)
Engineering	280	162 (57.9)	118 (42.1)	102 (36.4)	178 (63.6)	57 (20.4)	223 (79.6)	93 (33.2)	187 (66.8)	137 (48.9)	143 (51.1)	23 (8.2)	257 (91.8)	48 (17.1)	232 (82.9)	77 (27.5)	203 (72.5)	150 (53.6)	130 (46.4)	226 (80.7)	54 (19.3)
Law	161	75 (46.6)	86 (53.4)	64 (39.8)	97 (60.2)	61 (37.9)	100 (62.1)	71 (44.1)	90 (55.9)	73 (45.3)	88 (54.7)	0	161 (100)	47 (29.2)	114 (70.8)	89 (55.3)	72 (44.7)	95 (59.0)	66 (40.9)	137 (81.4)	24 (14.9)
Life science	232	148 (63.8)	84 (36.2)	80 (34.5)	152 (65.5)	36 (15.5)	196 (84.5)	66 (28.4)	166 (71.6)	81 (34.9)	151 (65.1)	16 (6.9)	216 (93.1)	45 (19.4)	187 (80.6)	58 (25.0)	174 (75.0)	133 (57.3)	99 (42.7)	161 (69.4)	71 (30.6)
Management Science	280	131 (46.8)	149 (53.2)	121 (43.2)	159 (56.8)	116 (41.4)	164 (58.6)	110 (39.3)	170 (60.7)	190 (67.9)	90 (32.1)	0	280 (100)	98 (35.0)	182 (65.0)	132 (47.1)	148 (52.9)	143 (51.1)	137 (48.9)	206 (73.6)	74 (26.4)
Physical science	160	121 (75.6)	39 (24.4)	75 (46.9)	85 (53.1)	63 (39.4)	97 (60.6)	81 (50.6)	79 (49.4)	68 (42.5)	92 (57.5)	42 (26.2)	118 (73.8)	68 (42.5)	92 (57.5)	64 (40.0)	96 60.0)	60 (37.5)	100 (62.5)	68 (42.5)	92 (57.5)
Social science	268	170 (63.4)	98 (36.6)	139 (51.9)	129 (48.1)	129 (48.1)	139 (51.9)	133 (49.6)	135 (50.4)	117 (44.7)	151 (56.3)	40 (14.9)	228 (85.1)	101 (37.7)	167 (62.3)	97 (36.2)	171 (63.8)	139 (51.9)	129 (48.1)	171 (63.8)	97 (36.2)
TOTAL	2000 (100)	1177 (58.8)	823 (41.2)	829 (41.5)	1171 (58.6)	610 (30.5)	1390 (69.5)	767 (38.4)	1233 (61.7)	931 (46.6)	1069 (53.5)	197 (9.9)	1803 (90.2)	576 (28.8)	1424 (71.2)	739 (37.0)	1261 (6.31)	1067 (53.4)	933 (46.7)	1419 (71.0)	581 (29.1)

N represents the number of respondent. P represents the presence of the traits. A represents the absence of the traits. Values in parenthesis represent the percentage of the occurrence.

Table 2: Allelic Frequency of Ten Morphometric Traits among University of Ilorin Student

FACULTY	Tongue Rolling		Widow's Peak		Chin cleft		Dimple		Free earlobe		Achoo Syndrome		Bent little finger		Early onset myopia		Hand Clasping		Hair Phalanges	
	p	q	p	q	p	q	p	q	p	q	p	q	p	q	p	q	p	q	p	q
Agriculture	0.35	0.65	0.20	0.80	0.10	0.90	0.19	0.81	0.29	0.71	0.05	0.95	0.09	0.91	0.15	0.85	0.32	0.68	0.56	0.44
Art	0.37	0.63	0.20	0.80	0.10	0.90	0.17	0.83	0.22	0.78	0.08	0.92	0.47	0.53	0.19	0.81	0.28	0.72	0.36	0.64
Education	0.61	0.39	0.30	0.70	0.17	0.83	0.22	0.78	0.21	0.79	0.08	0.92	0.24	0.76	0.29	0.71	0.41	0.59	0.46	0.54
Engineering	0.35	0.65	0.20	0.80	0.10	0.90	0.19	0.81	0.49	0.51	0.04	0.96	0.09	0.91	0.16	0.84	0.32	0.68	0.56	0.44
Law	0.27	0.73	0.22	0.78	0.20	0.80	0.26	0.74	0.26	0.74	0.00	1.00	0.16	0.84	0.33	0.67	0.36	0.64	0.61	0.39
Life science	0.40	0.60	0.20	0.80	0.10	0.90	0.16	0.84	0.35	0.65	0.04	0.96	0.10	0.90	0.13	0.87	0.35	0.65	0.45	0.55
Management	0.27	0.73	0.25	0.75	0.20	0.80	0.23	0.77	0.43	0.57	0.00	1.00	0.19	0.81	0.27	0.73	0.30	0.70	0.49	0.51
Physical science	0.51	0.49	0.30	0.70	0.20	0.80	0.23	0.77	0.24	0.76	0.14	0.86	0.24	0.76	0.23	0.77	0.21	0.79	0.24	0.76
Social science	0.40	0.60	0.30	0.70	0.28	0.72	0.30	0.70	0.44	0.56	0.08	0.92	0.21	0.79	0.20	0.80	0.31	0.69	0.40	0.60
T TOTAL	0.36	0.64	0.23	0.77	0.17	0.83	0.21	0.79	0.27	0.73	0.05	0.95	0.16	0.84	0.21	0.79	0.32	0.68	0.46	0.54

P represents the frequency of dominant alleles. q represents the frequency of recessive alleles.

Table 3: Genotypic Frequency of Ten Different Morphometric Traits among Students of University of Ilorin, Ilorin Nigeria.

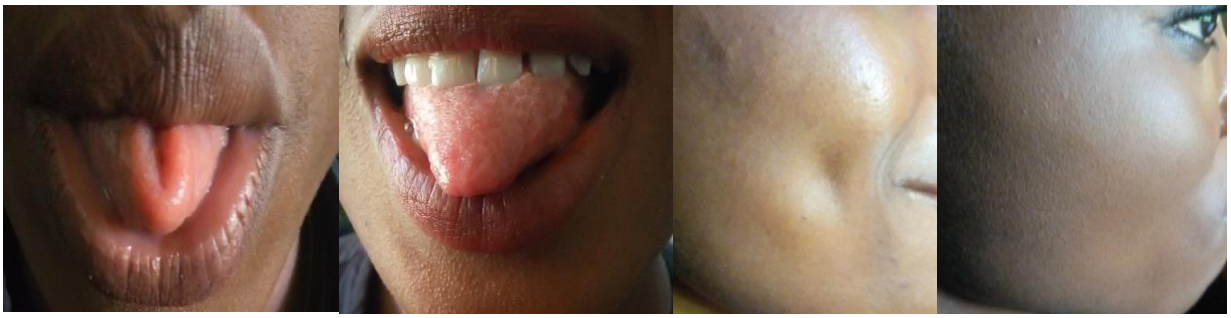
	Tongue rolling			Widow's peak			Chin cleft			Dimple		
Faculty	P^2N	2pqN	Q^2N	P^2N	2pqN	Q^2N	P^2N	2pqN	Q^2N	P^2N	2pqN	Q^2N
Agriculture	34.42	127.86	118.72	11.71	91.76	178.05	2.81	50.58	227.61	10.14	86.49	184.36
Art	20.67	70.40	59.93	7.58	52.49	90.93	1.51	27.18	122.31	4.36	42.61	104.02
Education	69.58	88.97	28.44	12.78	72.13	102.12	5.40	52.77	128.82	9.05	64.17	113.77
Engineering	34.46	127.40	118.30	11.50	90.60	177.80	2.80	50.40	226.8	10.10	86.18	183.70
Law	11.66	63.47	85.80	8.08	55.97	96.95	6.44	51.52	103.04	10.88	61.95	88.16
Life Sciences	37.12	113.36	83.52	8.43	71.40	151.84	2.32	41.76	187.92	5.93	62.36	163.69
Management Sciences	20.49	110.38	149.21	17.00	103.87	159.18	11.20	89.60	179.20	14.81	99.17	166.01
Physical Sciences	41.62	79.97	38.42	11.76	63.22	85.03	6.40	51.20	102.40	8.46	56.67	94.86
Social Sciences	42.88	128.64	96.48	25.09	113.83	129.08	21.01	108.05	138.93	24.12	112.56	131.32
Total	312.1	910.45	777.5	113.93	715.27	1170.98	59.89	523.06	1417.03	77.03	692.16	1230.82

Table 4: Genotypic Frequency Of Ten (10) different Morphometric Traits among Students of University of Ilorin, Ilorin Nigeria Cont'd.

	Hand clasping			Hair phalanges			Early onset myopia			Bent little finger		
Faculty	P^2N	2pqN	Q^2N	P^2N	2pqN	Q^2N	P^2N	2pqN	Q^2N	P^2N	2pqN	Q^2N
Agriculture	28.77	122.29	129.93	88.12	54.40	138.48	6.32	71.66	203.02	2.28	46.03	232.70
Art	11.84	60.88	78.28	19.57	61.85	69.58	5.45	46.48	99.07	33.36	75.23	42.42
Education	31.43	90.47	65.09	39.57	54.53	92.90	15.73	77.01	94.23	10.77	68.22	108.01
Engineering	28.67	121.86	129.47	87.81	54.21	137.98	7.17	75.26	197.57	2.27	45.86	231.87
Law	20.87	74.19	65.95	59.91	24.49	76.60	17.53	71.19	72.27	4.12	43.28	113.60
Life Sciences	28.42	105.56	98.02	46.98	70.18	114.84	3.92	52.48	175.60	2.32	41.76	187.92
Management Sciences	25.20	117.60	137.2	67.22	72.83	139.94	20.41	110.38	149.21	10.11	86.18	183.71
Physical Sciences	7.06	53.09	99.86	9.22	92.42	58.37	8.46	56.67	94.86	9.23	58.37	92.42
Social Sciences	25.75	114.65	127.59	42.88	96.48	128.64	10.72	85.76	171.52	11.82	88.92	167.26
Total	208.01	860.59	931.39	461.28	581.39	957.33	95.71	646.89	1257.35	86.28	553.85	1359.91

Table 5: Genotypic Frequency of Ten (10) different Morphometric Traits among Students Of University of Ilorin, Ilorin Nigeria Cont'd.

	Free ear lobe			Achoo syndrome		
Faculty	P^2N	2pqN	Q^2N	P^2N	2pqN	Q^2N
Agriculture	23.63	112.96	142.97	0.70	26.70	253.60
Art	7.31	51.82	92.87	0.95	22.23	127.81
Education	8.25	62.05	117.81	1.20	27.53	158.28
Engineering	67.23	139.94	73.03	0.45	21.50	258.05
Law	10.97	61.95	88.16	0.00	0.00	161.00
Life Sciences	28.42	105.56	98.02	0.37	17.82	213.81
Management Sciences	52.74	137.26	90.97	0.00	0.00	280.00
Physical Sciences	9.22	58.37	92.42	3.14	38.53	118.34
Social Sciences	51.88	132.07	84.04	1.72	39.45	226.84
Total	259.45	861.18	880.29	8.53	193.76	1797.73



Tongue roller Non tongue roller Dimple Present Dimple Absent

Widow's peak present Widow's peak absent Attached ear lobe Free ear lobe

Figure 1: Morphometric traits of some students in University of Ilorin, Ilorin, Nigeria

CONCLUSION

Morphometric traits are observable features determined by specific segments of DNA called genes. Thus, since human population provides a whole opportunity to study the morphogenetic variation among the populations living in different ecosystem, this led to the present study among students of University of Ilorin. The study shows the frequencies of recessive alleles (q) were higher than the dominant alleles in all the traits. Also, the homozygous dominant genotypes in all the traits determined except the early onset myopia were less than the homozygous recessive and heterozygous genotypes. This study provides normative data for the distribution of the ten traits among the students of University of Ilorin

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