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Variations in Morphological Patterns of Lip Prints as Evidence in Racial and Sexual Discrimination

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Abstract

Introduction: The genetic heterogeneity among Different populations has been a great challenge in establishing ethnicity. The variation of lip print patterns in an ethnic population may be a unique feature of that population and therefore has an important role in forensic practice and criminal investigations.

Aim: The aim of the study was to ascertain whether there are any differences in the distribution of lip print pattern among different populations of Egyptian, Malaysian and Sudanese students.

Method: In this descriptive study, one hundred-Fifty Two lip prints (belonging to three different ethnic groups) were collected and recognized based on the sorting of Suzuki and Tsuchihashi's. Collected Data was statistically analysed.

Results: The result showed that Type I was the prevalent pattern among Egyptian males and females (48% and 41.4%). Type III showed high frequency in Malaysian female and males (34.0% and 30%). As regard Sudanese population Type I was the predominant pattern among males and females (37.9% and 38.0%). Chi square (χ^2) test was performed among lip print patterns of the studied populations, There was a statistically significant difference in lip print pattern Type I between Egyptian and Malaysian females And between Malaysian and Sudanese females. Lip print Type III and Type VI showed significant difference between Malaysian and Sudanese females. There was significant statistical difference among Egyptian and Malaysian males as regards distribution of lip print pattern Type I and Type VI.

Conclusion: Lip print patterns distribution showed Potential difference among the different population groups, this could help to make the search gap narrower in forensic purposes and criminal investigations.

Keywords: Cheiloscopy; Lip prints; Sex; Ethnicity; Egyptian; Sudanese and Malaysian

Introduction

Identification of sex and ethnicity well known to have an inevitable role in the fields of forensic medicine and criminal aspects [1]. Dental, fingerprint and DNA comparison considered the most common techniques permitting rapid and secure personal identification.

Criminals now realize fingerprints importance so usually there are intended trials not to leave behind fingerprints at scene of the crime. Because of that, other techniques Such as lip prints should employed for solving crimes [2]. Moreover, increase the chances of person identification [3].

Lip prints consisting of lines and fissures in the forms of wrinkles and grooves present in the zone of human lip transition [4]. Lip print study (cheiloscopy) has been proved as emerging discriminatory tool in forensic criminology because of the anatomical uniqueness of the labial grooves [5]. They remain stable over time and because they are exclusively unique to every individual including twins [6]. The significance of cheiloscopy is related to the fact that lip prints are inherent, permanent once developed at the 6th month of intrauterine life and unalterable even after death [7].

Lip prints could be left at crime scenes on many objects e.g., cigarette butts drinking glasses, napkins, cakes, papers, duct tape (that used to tie a victim). Pattern study of the lip prints present at a scene of crime, and their comparison with those of the suspected person may be useful for identification [8].

It has been stated that lip prints recover after exposure to trauma, inflammation and diseases as herpes and that the disposition and shape of the furrows does not altered by the environmental factors. However, major trauma to lips may lead to pathos is, scarring and the surgical interference for lip rectification may change the shape and size of the lips, thereby modifying the pattern and morphology of grooves [9].

The genetic heterogeneity among different populations has been an immense challenge in determining ethnicity. The diversity of lip print patterns in an ethnic group may be a peculiar property of that population and therefore aid in forensic investigations. Lip prints can serve as genetic indications of many congenital anomalies [10]. Recent

studies have proved that the similarity of lip print patterns of a child is closer to the mother (57.89%) than the father (42.22%) [11].

Aim

The aim of the study was to ascertain whether there are any differences in the distribution of lip print pattern among different populations of Egyptian, Malaysian and Sudanese.

Materials and Methods

Subjects

The study was performed on randomly selected one hundred and Fifty Two volunteers students classified into three ethnic groups; Fifty-four adult Egyptians (25 males and 29 females), Fifty adult Sundaneses (24 males and 26 females) and Forty-Eight adult Malaysian (22 males and 26 females) all participants were medical students studying in Cairo University – Faculty of medicine, Egypt. Each participant informed about the study protocol and purpose signed consent obtained. The Ethics Committee of Faculty of Medicine, Cairo University approved the study.

Inclusion and exclusion criteria

Lips that were normal and free of any abnormality or disease were included in the study. Lips with evidence of inflammation, disease or injury were excluded. Participants with known to lipsticks hypersensitivity or showing any other abnormality of the lip were excluded from the study.

Lip print recording

Red or brown, non-glossy, non-persistent, non-metallic lip stick was used to obtain clear lip prints. White papers (white A4 roco premium 80-g copy papers) and tissue papers (kleenex) were utilized to get the impressions. Each participant was asked to clean the lip properly a thin layer of lipstick was applied onto the cleaned and dried lips, the subjects were asked to rub both lips to spread the applied lipstick uniformly, left for 3 min. Direct light pressure was applied by the lips on a standardized properly folded paper then they were kept in a card board box under suitable environmental conditions. At least four prints taken from each participant to be sure that we had at least one clear, well-defined print for satisfactory examination of various lip compartments, and to avoid subjective pressure difference applied to the folded paper.

Analysis of the lip print

The lip prints were divided into four quadrants for analysis (Figure 1). Upper right quadrant (URQ, Q1), the upper left quadrant (ULQ, Q2), the lower left quadrant (LLQ, Q3), and the lower right quadrant (LRQ, Q4). The obtained prints were first investigated by magnifying hand lenses (with direct light focused on it) to pick out the best clear complete print where the groove Types could be visualized and analyzed. The best-visualized print of each participant was photographed by a digital camera and analyzed by the picture manager programs to determine the Predominant Groove Type in the examined areas. Each quadrant examined separately to detect the characteristic pattern of the grooves. The analysis of the prints depends on the numerical superiority of the patterns [12]. Moreover, the Type that was repeated in maximum number of times was considered as lip print

Type. These findings were separately entered in Microsoft Excel sheet and statistically analyzed. Examination of lip print patterns based on the categorization of Suzuki and Tsuchihashi's [13] (Figure 2):

Type I – A clear–vertical groove across the lip (complete vertical)

Type I' – Partial-length groove of Type I

Type II – A branched or Yshaped pattern

Type III – An intersected or criss-cross pattern

Type IV – A reticular pattern

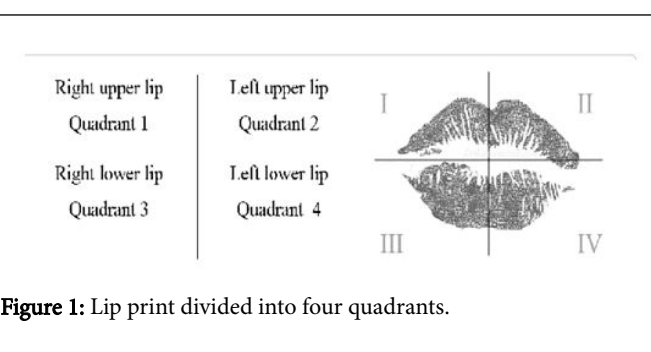**Type V** – Other patterns (Undetermined)

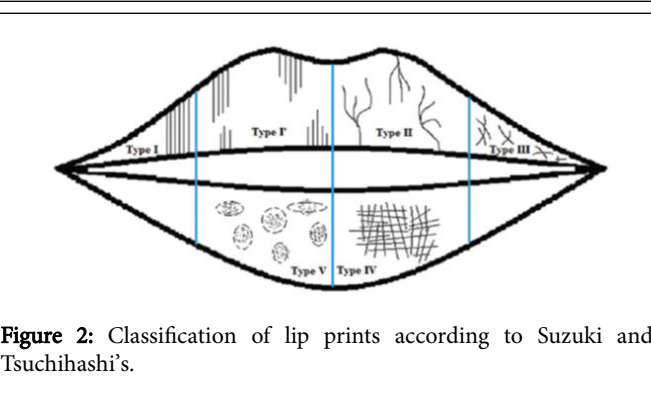**Figure 1:** Lip print divided into four quadrants.

Figure 2: Classification of lip prints according to Suzuki and Tsuchihashi's.

Statistical analysis

The statistical package for the Social Sciences (SPSS) version 25 were used for Data coding and entering (IBM Corporation, Armonk, NY, USA). Data was summarized by obtaining mean and standard deviation for quantitative variables and frequencies (number of cases). For categorical variables, relative frequencies (percentages) were used. Chi square ($\chi2$) test was performed for comparing categorical data, Exact test was used instead when the expected frequency is less than 5 [14]. P-values less than 0.05 were considered as statistically significant.

Results and Discussion

A total of one hundred and Fifty Two volunteer students their ages ranged from (18-25 years) were enrolled in this study, divided into 3 racial groups; Egyptians, Sudanese and Malaysian groups.

As shown in Figure 3, Type I (complete vertical) pattern was the predominant pattern between all studied populations (32%), while Type V (undermined) was the least detected in all populations (5.3%). Figure 4 illustrated that lip print Type I represented the highest frequent pattern seen between Egyptian and Sudanese groups (44.4%

and 38.0% respectively) while Type III was the most observed pattern among Malaysian and Egyptian populations (32.6% and 25.9% respectively).
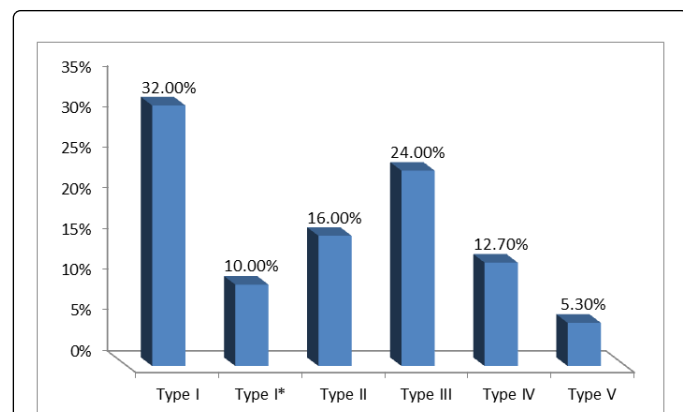

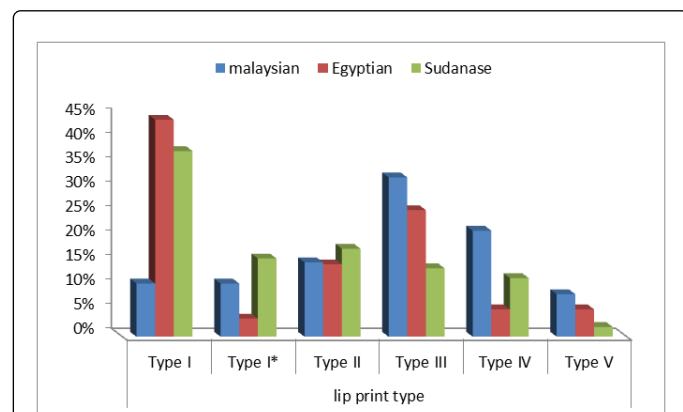**Figure 3:** Types of lip print pattern through the entire study.

Figure 4: Lip print pattern prevalence among the studied populations.
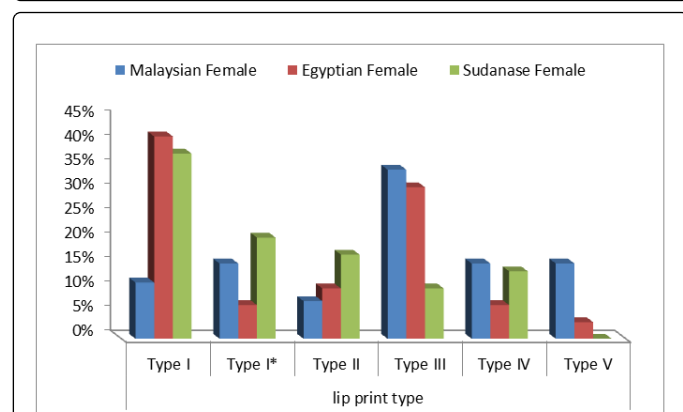

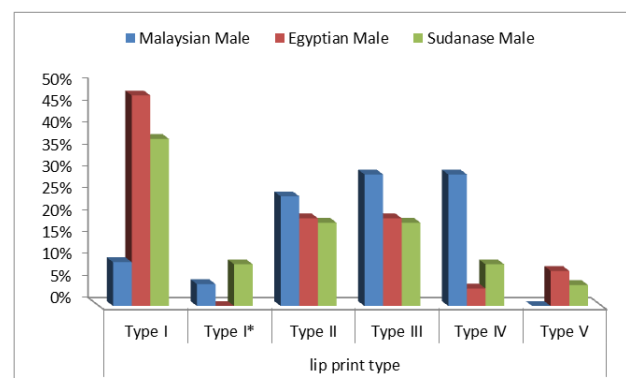**Figure 5:** Types of lip print pattern among females in studied population.

Figure 6: Types of lip print patterns among males in studied population.

As seen in Figures 5 and 6, Type I was the most common detected pattern among Egyptian males and females (48% and 41.4% each), respectively, followed by Type III in females (31%) and Type II in males (20%), Type III was dominant among Malaysian males and females (30% and 34.0% respectively), in Sudanese population Type I was the commonest pattern among males and females (37.9% and 38%) respectively, followed by Type I' in females (20.7%).

Chi square (χ^2) test was performed to assess racial differences among the studied populations. There was significant difference in lip print pattern Type I between Egyptian and Malaysian females (p=0.013). And between Malaysian and Sudanese females (p=0.025) as shown in Table 1. Lip print patterns Type III and Type VI showed significant difference between Malaysian and Sudanese females (p=0.030 and 0.044) respectively. A statistically significant difference was found in lip print pattern Type I (p=0.006) and Type VI distribution (p=0.034) among Egyptian and Malaysian males as shown in Table 2.

Female lip print Type	Malaysian vs. Egyptian	Malaysian vs. Sudanase	Egyptian vs. Sudanase
	P-value	P-value	P-value
Type I	0.013*	0.025*	0.788
Type I*	0.406	0.733	0.253
Type II	1	0.426	0.706
Type III	0.778	0.030*	0.052
Type IV	0.406	1	0.67
Type V	0.178	0.044*	1

Table 1: P-values illustrating relationship of lip print patterns distribution among females of the studied populations (*Significant difference (P<0.05); vs=versus).

As seen in Tables 3 and 4, URQ (upper right Quadrant) Type II was dominant among males and females of Egyptian population (28% each) and males of Malaysian population (45%) while Type III was most prevalent among Sudanese males and females population (38% and 34.5% respectively). In ULQ (upper left Quadrant), Type I was the

most frequent pattern among Egyptian and Sudanese males (32% and 32.6% respectively) and among Malaysian and Sudanese females (34.6% and 27.6% respectively). Type II and III were the commonest among Malaysian and Sudanese males (25% and 28.6 respectively) (Figure 7).

Males lip print Type	Malaysian vs. Egyptian	Malaysian vs. Sudanase	Egyptian vs. Sudanase
	P value	P value	P value
Type I	0.006	0.067	0.5
Type I*	0.444	1	0.203
Type II	0.731	0.719	1
Type III	0.5	0.484	1
Type IV	0.034	0.13	0.585
Type V	0.495	1	1

Table 2: P- values illustrating relationship of lip print patterns distribution among males of the studied populations (*Significant difference (P<0.05); vs.=versus).
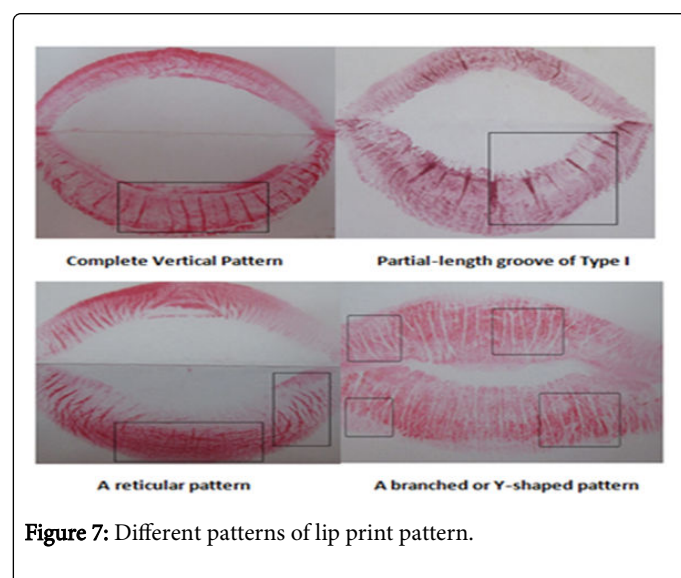

Figure 7: Different patterns of lip print pattern.

Region/pattern	Malaysian No (%)	Egyptian No (%)	Sudanese No (%)	P-value
URQ				
Type I	4 (20%)	5 (17.2%)	6 (20.7%)	0.277
Type I"	7 (26.9%)	5 (17.2%)	1 (3.4%)	
Type II	4 (15.4%)	8 (28.0%)	8 (27.6%)	
Type III	5 (19.2%)	6 (20.7%)	10 (34.5%	
Type VI	2 (7.7%)	2 (6.9%)	4 (13.8%)	
Type V	2 (7.7%)	3 (10.3%)	0 (0.0%)	
ULQ				
Type I	9 (34.6%)	5 (17.2%)	8 (27.6%)	
Type I"	3 (11.5%)	3 (10.3%)	5 (17.2%)	0.232
Type II	2 (7.7%)	8 (27.6%)	6 (20.6%)	
Type III	3 (11.5%)	5 (17.2%)	8 (27.6%)	
Type VI	6 (23.1%)	5 (17.2%)	1 (3.4%)	
Type V	3 (11.5%)	3 (10.3%)	1 (3.4%)	
LRQ				
Type I	3 (11.6%)	7 (24.1%)	10 (34.4%)	
Type I"	4 (15.4%)	3 (10.3%)	7 (24.1%)	
Type II	7 (26.9%)	7 (24.1%)	5 (17.3%)	0.058
Type III	7 (26.9%)	9 (31%)	1 (3.4%)	
Type VI	5 (19.2%)	2 (6.9%)	6 (20.7%)	
Type V	0 (0.0%)	1 (3.4%)	0 (0.0%)	
LLQ				
Type I	4 (15.4%)	9 (31%)	9 (31%)	
Type I"	2 (7.7%)	1 (3.4%)	7 (24.1%)	0.135
Type II	5 (19.2%)	8 (27.6%)	7 (24.1%)	
Type III	6 (23.0%)	5 (17.2%)	4 (13.8%)	
Type VI	5 (19.2%)	5 (17.2%)	2 (6.9%)	
Type V	4 (15.4%)	1 (3.4%)	0 (0.0%)	

Table 3: Chi square (^{2}) analysis of different patterns distribution by different quadrants among females participants included in the study (*Statistically significant at P<0.05).

Region/pattern	Malaysian No (%)	Egyptian No (%)	Sudanese No (%)	P-value
URQ				
Type I	6 (23.1%)	4 (16.0)	4 (19.0%)	
Type I"	0 (0.0%)	7 (28.0)	1 (4.8%)	0.075
Type II	9 (45.0%)	7 (28.0)	7 (33.3%)	
Type III	3 (15.0%)	3 (12.0)	8 (38.1%)	
Type VI	4 (20.0%)	3 (12.0)	1 (4.8%)	
Type V	0 (0.0%)	1 (4.0%)	0 (0.0%)	
ULQ				
Type I	4 (20%)	8 (32%)	6 (28.6%)	
Type I"	2 (10%)	3 (12%)	2 (9.4%)	0.721
Type II	5 (25%)	4 (16%)	6 (28.6%)	
Type III	5 (25.0%)	4 (16%)	6 (28.6%)	
Type VI	4 (20.0%)	6 (24%)	1 (4.8%)	
Type V	0 (0.0%)	0 (0.0%)	0 (0.0%)	

LRQ				
Type I	1 (5%)	9 (36%)	7 (33.4%)	
Type I"	5 (25%)	2 (8%)	3 (14.3%)	0.1
Type II	3 (15%)	7 (28%)	3 (14.3%)	
Type III	7 (35.0%)	5 (20%)	3 (14.3%)	
Type VI	4 (20.0%)	1 (4%)	4 (19%)	
Type V	0 (0.0%)	1 (4%)	1 (4.8%)	
LLQ				
Type I	4 (20%)	7 (28%)	10 (47.6%)	
Type I"	3 (15%)	3 (12%)	0 (0.00%)	0.588
Type II	6 (30%)	4 (16%)	4 (19%)	
Type III	4 (20.0%)	5 (20%)	3 (14.3%)	
Type VI	3 (15.0%)	4 (16%)	3 (14.3%)	
Type V	0 (0.0%)	2 (8%)	1 (4.8%)	

Table 4: Chi square (^{2}) analysis of different patterns distribution by different quadrants among males participants included in the study (*Statistically significant at P<0.05).

In LRQ (Lower Right Quadrant): Egyptian males, Sudanese males and females had predominance of Type I (36%, 33.4% and 34.5% respectively), while Malaysian males and females showed high frequency of Type III (35% and 26% respectively). In LLQ (lower left Quadrant): Malaysian, Egyptian and Sudanese males had predominance of Type I (20%, 28% and 47% respectively),while Egyptian and Sudanese females showed high frequency of Type II (27.6% and 24.1% respectively) . Chi-square test revealed no statistical significance difference between lip print patterns among quadrants when compared between countries; P ≤ 0.05.

Discussion

Despite that lip print can be used effectively for personal identification. Some of the crime scene investigators ignore it. Cheiloscopy plays an essential role for transfer and proving of evidence for the criminal and forensic practice and is considered of the same importance as fingerprints in forensic and personal identification [15]. DNA could be retrieved from the lip prints which increase its identifying value in forensic [16].

In the present study, lipstick and filter paper were used for lifting lip prints; as it is simple, rapid, easy to apply, provides clear prints that improve the visualization of the lip print. So it was preferred than using cellophane tape; as the latter can be painful to the participant and may cause minor lip injuries and requires certain precautions during application and lifting from the lip in order to prevent any alteration of the lip print [16]. Suzuki and Tsuchihashi's classification was selected to investigate the grooves of lip prints; as this classification is the most widely used. It provides easy interpretation and clear description for almost all pattern of lip prints [17]. Lip print pattern for each individual is peculiar as no two lip print patterns are alike [18]. Throughout this study, no subject had single pattern of lip print in all areas of the lip. Our results were in accordance with that reported by

Ragab et al. During his study on sample of the Egyptian population at Dakahleya governorate who revealed that no person had a single Type of lip print and no two or more individuals had similar characters of lip grooves [19]. The individuality of lip prints in people of Chennai, India was proved by Uma Maheswari et al. who stated that no person had a single groove Type in all areas of the lip [20]. On the other hand El Domiaty et al. stated that few numbers of prints (9.63%) showed only one Type of grooves in all lip quadrants, but two or more Types of grooves were frequently seen in various parts of the print in his study on people in Saudi Arabia at Almadinah Almonawarah province [21].

The present study showed that Type V (undetermined other pattern) was the least observed in all populations. Similar results were approved by Hamzah NH et al. [22]. Moreover, in a study done on three different races (Indians, Chinese and Malay) in 2014; Type V showed complete absence among the Chinese population and was the least noticed among the Malaysians and the Indians. On the other hand, our results showed that Type I and Type III (32% and 24% respectively) represented the most frequently detected pattern in the entire sample, Type I was the most prevalent In the Egyptian and Sudanese populations, our result is in agreement with study done in Dakahlia in Egypt [19] recorded that the highest recorded lip print among the studied Egyptian sample was Type I (complete vertical) in both sexes. Also Gunasekaran et al. in his study conducted for lip print pattern comparison between Indian and African students reported that Type III was the most prevalent pattern of lip print in African population for males (40%) and Type I (46%) was the most prevalent in females [23]. Also our results were in line with Ayuba et al. study which performed Among Ugandan, Kenyan and Somali Population and proved that Lip print Type I and I' dominate in a percent of 60-100% in both sexes of all countries [24]. However, results of this work partially disagree with Abdel Aziz et al. [25] results stating the predominance of Type III lip print pattern in both the Egyptian and Malaysian populations. In line with Bindal et al. study on Indian populations, Type II was the most prevalent Type in both males and females. While Type III was the least detected irrespective of the quadrant studied [26] this could be described by the variations in ethnicity and geographical regions of the studied subjects.

The present study showed that Type III and IV dominate in Malaysian male (30% each) and Type III was highest frequent in Malaysian females (34.6%). Our results were similar to Abdel Aziz et al., results who revealed that Type III pattern was the most frequent in Malaysian populations also this is in accordance with the findings reported by Hamzah NH et al. [22]. Various authors reported different results; Bindal et al., and Durbakula et al. reported that Type I was the dominant pattern seen in Malaysian population. This could be explained by the cultural diversity in a country as Malaysia with three major races, Malaysian, Chinese, and Indian [26,27]. Significant differences were observed in the present study between both sexes in Egyptian, Malaysian and Sudanese populations as certain pattern of lip print distribution were prevalent in either males or females. Therefore, lip print can be considered as a reliable method in sex determination. The findings coincide with the findings of Hamzah NH et al. on Malaysians population [22], Sharma et al. on Indian populations [28] and Ayuba et al. In his study on Ugandan, Kenyan and Somali Population [24]. Whereas contradictory results were reported by Peeran et al. [29]

As regards, Quadrant wise prevalence of lip print patterns; no statistically significant difference was seen among the studied groups, where Type I predominated among Malaysian females in Q1 and Q2,

while Type III was frequently detected in Q3 and Q4. A predominance of Type II was obvious among Egyptian and Malaysian females in all lip quadrants, Type V showed the least frequency pattern among all populations with complete absence in all quadrants of Sudanese females except Q2. On the other hand males of the studied populations showed a high frequency of Type II in quadrant 1 while high frequency of Type II was observed in all quadrants except in Q3 for Malaysian males where Type III predominates, Type V was the least noticed in all lip areas with complete absence in all lip quadrants of Malaysian males and in Sudanese males as regards Q1 and Q2.

In the study conducted by Ayuba et al. on African populations showed that Somalis were characterized by presence of Type IV in their lower lip quadrants, Type III revealed highest incidence among Kenyans while Ugandans generally showed deficiency of Type III and IV in their right upper quadrant, no statistically significant difference was found as regards pattern distribution in different lip quadrants of the individuals except Type IV which was significantly different among Somalis and Kenyans also among Ugandans and Somalis [24]. Recently Kapoor and Badiye who studied lip prints in Indian subjects; stated that the frequency of Type V was higher in lower quadrants than the upper ones [30]. In a previous research of 200 participant of Mangalore in India, it was found that among females, Type I' showed the highest incidence followed by Type II, Type III, Type IV, Type I and Type V [31]. Generally, the observed variations in lip print patterns from our study can be explained on the basis of ethnic and racial background and environmental factors. Another factors such as relaxation of lip muscles and grooves on the lips and the upper lip hydration than lower lip and the continuousness of lips with adjacent skin lines can explain the differences in lip pattern.

Conclusion

This work explored the importance of studying the unique identical grooves appearing on the lip print, in addition the whole morphological patterns because of their individual uniqueness. Based on the observed variations of lip print pattern, we would like to justify that lip prints can be used for sex and ethnicity differentiation.

Recommendations

- Finding Alternative methods to collect lip prints for example; photographs, the use of impression materials. Might result into a better image of individual lip prints for analysis.
- Further studies among different age groups and different races by using large sample sizes to confirm the results and validate lip print as useful tool for personal identification and to prove guidelines for racial predilection.
- As lip prints remain stable overtime, we recommend Database generation for all individuals in a certain area with intentions to be as reference in civil issues and criminal cases.
- To determine the genetic role, further investigations are recommended among individuals of the same family and between twins.

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