

Kertas Asli/Original Articles

Lip Print Analysis in Malaysian Chinese Population (Klang Valley): Lipstick-Cellophane Tape Technique

(Analisis Cap Bibir Populasi Cina Malaysia di Lembah Klang: Teknik Gincu-Pita Selofan)

NOOR HAZFALINDA HAMZAH, AMALINA FARHATUL FARIDA MOHAMAD SELIMAN, KHAIRUL OSMAN & GINA FRANCESCA GABRIEL

ABSTRACT

Cheiloscopy is recognized as a tool for personal identification due to its strength in criminalistics. In this study, the lip print of Malaysian Chinese population in Klang Valley was used for gender determination using lipstick-cellophane technique. 412 subjects (203 males and 209 females) were selected conveniently. Lipstick was first applied on the lips and the lip print was lifted using cellophane tape prior to pasting them onto a plain A4 paper and analysis using magnifying glass. Six topography areas of lip prints were classified using Suzuki and Tsuchihashi's classification, including upper left, upper middle, upper right, lower right, lower middle and lower left. Chi-square test showed that all lip sections were significantly different from each other ($p < 0.05$). Type II was the dominant pattern in four lip sections for both genders: upper left (male 81.3%, female 57.4%), upper right (male 71.9%, female 42.9%), lower left (male 98.0%, female 90.0%) and lower right (male 96.1%, female 86.1%). Type IV was the dominant pattern for both middle part of the lips; upper middle (male 56.2%, female 50.7%) and lower middle (male 62.6%, female 50.2%). The results showed that gender can be differentiated based on lip print patterns. This finding suggested that cheiloscopy could be used in aiding personal identification for forensic investigation.

Keywords: Lip print; Malaysian Chinese; gender determination; lipstick-cellophane technique; Suzuki and Tsuchihashi's

ABSTRAK

Analisis cap bibir (cheiloscopy) telah dikenali sebagai alat untuk identifikasi di dalam bidang kriminalistik kerana kekuatannya. Di dalam kajian ini, cap bibir populasi Cina di Lembah Klang, Malaysia telah digunakan untuk penentuan jantina berdasarkan penggunaan teknik gincu-pita selofan. Seramai 412 subjek (203 lelaki dan 209 perempuan) telah dipilih secara santai. Pada mulanya, gincu telah disapukan pada bibir subjek dan kemudian cap bibir diambil menggunakan pita selofan sebelum dilekatkan ke atas kertas A4 dan dianalisa menggunakan kanta pembesar. Cap bibir diklasifikasikan kepada 6 bahagian termasuklah kiri atas, tengah atas, kanan atas, kanan bawah, tengah bawah dan kiri bawah menggunakan klasifikasi Suzuki dan Tsuchihashi. Ujian khi-square menunjukkan terdapat perbezaan yang signifikan pada semua bahagian bibir ($p < 0.05$). Jenis II adalah yang paling dominan untuk 4 bahagian bibir bagi kedua-dua jantina: bahagian kiri atas (lelaki 81.3%, perempuan 57.4%), kanan atas (lelaki 71.9%, perempuan 42.9%), kiri bawah (lelaki 98%, perempuan 90%) dan kanan bawah (lelaki 96.1%, perempuan 86.1%). Jenis IV adalah dominan untuk kedua-dua bahagian tengah bibir; tengah atas (lelaki 56.2%, perempuan 50.7%) dan tengah bawah (lelaki 62.6%, perempuan 50.2%). Keputusan ini menunjukkan jantina boleh ditentukan berdasarkan analisis cap bibir. Hasil kajian ini mencadangkan analisis cap bibir boleh digunakan untuk membantu proses identifikasi terutama dalam bidang siasatan forensik.

Kata kunci: Cap bibir; populasi Cina di Malaysia; penentuan jantina; teknik gincu-pita selofan; Suzuki dan Tsuchihashi

INTRODUCTION

Personal identification plays a significant role in crime investigations, either in narrowing down suspects or confirming someone's presence at a crime scene. Personal identification is usually made by comparing the ante-mortem records of dental and fingerprints with the

postmortem record (Saraswathi et al. 2009), however, the pattern of wrinkles on the lips also has individual characteristics like fingerprints, hence lip print can be used for personal identification in crime investigations (Kasprzak 1990).

The wrinkles and grooves on labial mucosa, known as *sulci labiorum*, forms a characteristic pattern called lip

prints and the study of lip print is known as cheiloscropy. Lip prints are usually left at crime scenes and can provide a direct link to the suspect (Randhawa et al. 2011). The analysis of the lip prints left at the scene of a crime and their comparison with those of a suspected person constitutes an important tool for identification and it is often considered the key in solving a crime (Eldomiaty et al. 2014). Furthermore, lip print is stable over time; therefore can be used as supportive evidence in various crime investigations (Eldomiaty et al. 2014).

Cheiloscopic evidence was admissible in court back in the 1930's when Edmond Locard acknowledged the importance of cheiloscropy (Thomas & van Wyk 1988). Since then many researchers came out with various classification of lip prints (Santos 1967; Tsuchihashi 1974) however, Suzuki and Tsuchihashi classification was chosen by many researchers due to its simplicity (Prabhu et al. 2013). Hence, this current study used Suzuki and Tsuchihashi classification for lip print analysis. Based on Suzuki and Tsuchihashi classification, the lip print pattern was classified into 6 different types: type I (complete straight groove), type I' (partial straight groove), type II (branched groove), type III (intersected groove), type IV (reticular groove) and type V (irregular pattern) (Tsuchihashi 1974).

The aim of this study is to differentiate gender based on lip print in Malaysian Chinese population using lipstick-cellophane tape technique. Cheiloscropy researches are not fully discovered in Malaysia. Previous researchers (Durbakula et al. 2015; Neo et al. 2012) analysed Malaysian Malay and Chinese population in Malaysia; however, the sample size studied was small (less than 100). Other researchers in Malaysia studied Malaysian Malay lip prints with various methods of lifting the lip print (Abdel Aziz et al. 2016; Nur Sabrina Sarah et al. 2019; Wan Rafiuddin et al. 2018). The results showed that type II, III and V were the dominant lip print pattern. Most cheiloscropy projects were from India for Indian population, as shown in Table 1. Four researchers studied only middle part of lip prints of Indian population (size samples were less than 400) and the dominant lip prints were type I, III and IV (Kinra et al. 2014; Multani et al. 2014; Remya et al. 2016; Verghese et al. 2010). Researchers from Pakistan and India used whole lips for their studies, with sample size of less than 400 and the dominant lip print patterns were type I and IV (Ishaq et al. 2018; Kautilya et al. 2013; Kumar et al. 2016). A lot of other researchers analysed 4 quadrants of lips in order to determine the dominant pattern in Indian population and the results showed that type I, I', II, III and V were among the dominant patterns (Bindal et al. 2009; Gondivkar et al. 2009; Kapoor & Badiye 2017; Nagrale et al. 2014; Prabhu et al. 2012). Most of these researchers have looked into lip

prints among Indian in India, Pakistanis, Malaysian Malay, however, less studies done for the Malaysian Chinese, therefore, for this current study, this is the first attempt to look into Malaysian Chinese lip prints for gender determination, using the lipstick-cellophane tape technique. This technique was preferred because it was less time consuming and easy to apply as the analysis can be done anywhere even at the crime scene itself.

METHODOLOGY

SAMPLES

412 samples comprising of 203 males and 209 females were selected conveniently among Malaysian Chinese population in the Klang Valley, Malaysia. No age limit was set in the study because lip print can be identified as early as sixth week of intrauterine life and it remains the same throughout an individual's life (Sultana et al. 2014) unless there is a trauma or injuries that can alter the lip print pattern. Written consent was obtained to ensure that all subjects fulfilled the inclusion and the exclusion factors. Ethical approval was also received from the institutional ethics committee (Code: UKM PPI/111/8/JEP-2018-133). Subjects used in this study were of pure Chinese descent for at least three generations. Subjects with inflammation, trauma, malformation, orthodontic treatment, ulcers, hypersensitivity to lipstick, defects or scars on lips, previous lip surgery, dried or chapped lips and deformities were excluded (Neo et al. 2012; Shah & Jayaraj 2015).

TECHNIQUE

Wet tissue was given to clean the subject's lip for removal of any impurities on the lip. *Silky Girl* code 03 Siren Red lipstick was applied evenly on the subject's lips using lip brush to avoid smudging. The subject was then asked to gently rub the lips together to spread the lipstick evenly. It was left to dry for 30 seconds. Lip impression was lifted using a strip of 45mm transparent cellophane tape and the subject was asked to not stretch their lips. The tape was lifted from one end to another to avoid smudging and then was pasted carefully on the A4 paper without any air bubbles or any lines forming during the process. This procedure was repeated three times without reapplying the lipstick, to ensure collection of one complete and clear lip print for identification. The A4 paper with the subject's lip print was labelled with a serial number and date for documentation purposes.

TABLE 1: Comparison of cheiloscopy studies from previous researches and the result from the current study

Authors	Population	No. of subject	Lifting technique	Area of study	Dominant pattern found
Multani S et al. (Multani et al. 2014)	Indian	200 (100 males+ 100 females)	Lipstick-cellophane tape technique	Middle part only	I
Kinra M et al. (Kinra et al. 2014)	Indian	40 (20 males+20 females)	Lipstick-cellophane tape technique-bond paper	Middle part only	III
Remya S et al. (Remya et al. 2016)	Indian	200 (100 males+ 100 females)	Lipstick-cellophane tape technique – scanning technique	Middle part only (lower)	IV
Verghese AJ et al. (Verghese et al. 2010)	Indian	100 (50 males+ 50 females)	Lipstick-cellophane tape technique-bond paper	Middle part only (lower)	IV
Kumar A et al. (Kumar et al. 2016)	Indian	90 (45 males+ 45 females)	Lipstick-bond paper technique	Whole lips	IV
Vijay Kautilya D et al. (Kautilya et al. 2013)	Indian	100 (50 males+ 50 females)	Lipstick-cellophane tape technique-bond paper	Whole lips	I
Ishaq et al. (Ishaq et al. 2018)	Pakistan	250 (125 males+ 125 females)	Lipstick-cellophane tape technique-bond paper	Whole lips	I
Koneru et al. (Koneru et al. 2013)	Indian	60 (30 males+30 females)	Lipstick-cellophane tape technique	4 quadrants	I
Kapoor N et al. (Kapoor & Badiye 2017)	Indian	200 (100 males+ 100 females)	Direct photography technique (Nikon D3100 14.2 MP)	4 quadrants	I
Bindal U et al. (Bindal et al. 2009)	Indian	50 (25 males+25 females)	Lipstick-bond paper technique	4 quadrants	II
Manipady (Manipady 2001-2002)	Indian and Chinese origin students	50 Indian + 50 Chinese	Not Available	Not Available	II
Gondivkar et al. (Gondivkar et al. 2009)	Indian	140 (70 males+ 70 females)	Lipstick-bond paper technique	4 quadrants	II
Nagrале et al. (Nagrале et al. 2014)	Indian	500 (250 males+ 250 females)	Lipstick-bond paper technique	4 quadrants	III
Prabhu RV et al. (Prabhu et al. 2012)	Indian dental students	100	Lipstick-cellophane tape technique– scanning technique (300dpi scanner)	4 quadrants	V
Durbakula et al. (Durbakula et al. 2015)	Indian and Malaysian dental students	64 (Indian: 16 males+16 females, Malaysian: 16 males+16 females)	Lipstick-cellophane tape technique-bond paper technique	4 quadrants	II (Indians) I' (Malaysians)
Neo et al. (Neo et al. 2012)	Malaysian Malays	88 (44 males+44 females)	Lipstick-cellophane tape technique	4 quadrants	I'
Neo et al. (Neo et al. 2012)	Malaysian Chinese	36 (18 males+18 females)	Lipstick-cellophane tape technique	4 quadrants	I
Ragab et al. (Ragab et al. 2013)	Egyptian population	955 (235 males+ 720 females)	Lipstick-paper technique and scanning technique (495MP)	6 sections	I – complete vertical (Renaud classification)
Abdel Aziz et al. (Abdel Aziz et al. 2016)	Malaysian and Egyptian	120 (Egyptian: 30 males+30 females, Malaysian: 30 males+30 females)	Lipstick-paper technique	4 quadrant	III in both Malaysian and Egyptian
Wan Rafiuddin et al. (Wan Rafiuddin et al. 2018)	Malaysian Malays	360 (180 males+ 180 females)	Lipstick-cellophane tape technique	6 sections	II
Nur Sabrina et al. (Nur Sabrina Sarah et al. 2019)	Malaysian Malays	360 (180 males+ 180 females)	Photograph on lipstick-cellophane tape technique (13MP mobile phone camera)	6 sections	V

ANALYSIS OF LIP PRINTS

All lip prints were divided into six topography sections as previously suggested (Nur Sabrina Sarah et al. 2019; Ragab et al. 2013; Wan Rafiuddin et al. 2018). These were: upper left (UL), upper middle (UM), upper right (UR), lower right (LR), lower middle (LM) and lower left (LL) as shown in Figure 1. The lip print impression was then studied using a magnifying glass to get a better vision of the pattern. The most dominant pattern in each section was recorded and classified according to Suzuki and Tsuchihashi's classification.

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) (Window version 22.0). Pearson Chi-square test was performed to determine significant differences in lip prints between gender based on previous researcher (Neo et al. 2012).

RESULTS AND DISCUSSION

Percentage of the dominant patterns of lip print for Malaysian Chinese population in Klang Valley are shown in Table 2.

The results showed that type II was the dominant type for four sections: upper left, upper right, lower right and

lower left, ranging from 57% to 94.4% while type IV was the dominant lip print pattern for upper middle (53.4%) and lower middle (56.3%) sections. Type I was only noted at upper left and upper right sections while type I' was absent from lower right section. Type III was seen in all sections with the highest in upper right (17.5%), upper middle (15%), lower middle (9.7%), upper left (9.5%), lower right (5.6%) and lower left (3.2%). Type V was seen more in lower middle section (9%) and less in lower left section (0.5%). Table 3 shows the percentage distribution of lip print pattern comparing males and females in Malaysian Chinese population in Klang Valley.

Based on Table 3, type II was the dominant type in both gender for upper left, upper right, lower right and lower left sections, ranging from 71.9% to 98.0% for males and 42.9% to 90.0% for females. Type IV was dominant in the upper and lower middle sections for both gender, ranging from 56.2% to 62.6% in males and 50.2% to 50.7% for females. Pearson chi-square test showed significant differences between male and female in all sections (Table 4), therefore, for this current study, genders of Malaysian Chinese population in Klang Valley can be differentiated based on lip prints patterns.

Table 5 shows percentages of lip print pattern in different section between males and females. For the upper left section, females showed higher percentage of lip print

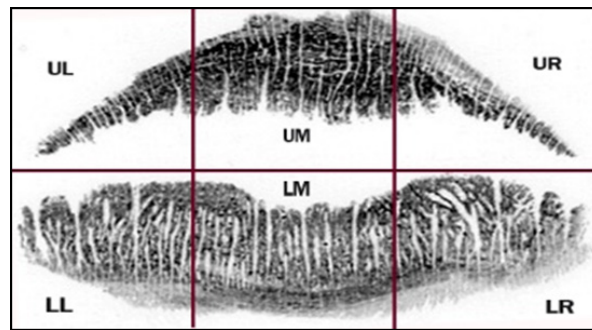


FIGURE 1: The six topography area of the lips named accordingly from left to right as upper left section (UL), upper middle section (UM), upper right section (UR), lower left section (LL), lower middle section (LM) and lower right section (LR) (Nur Sabrina Sarah et al. 2019)

TABLE 2: Percentage distribution of lip print pattern in Malaysian Chinese population

	UL	UM	UR	LL	LM	LR
Type I	2.7	0.0	2.7	0.0	0.0	0.0
Type I'	2.9	0.5	1.7	0.5	1.5	0.0
Type II	69.2	27.4	57.0	94.4	23.5	91.0
Type III	9.5	15.0	17.5	3.2	9.7	5.6
Type IV	12.6	53.4	18.4	1.5	56.3	2.7
Type V	3.2	3.6	2.7	0.5	9.0	0.7

patterns for all types ranging from 51.9% to 89.7%. Males dominated type II lip print pattern with 57.9%. For the upper middle section, only 2 females had type I' lip print pattern and females dominated type III and V while males dominated type II and IV. Type I was not found in either gender. Females again showed higher percentage of type I, I', III and V patterns while type II was higher in males for the upper right section. Type I' was only present in 7 females (100%). For the lower right section, only type II was high in males (52%) while type III, IV, V were high in females. Only 3 females had type V lip print pattern in this section hence the percentage was 100%. Type I and I' were not present in both gender. For the lower middle section, type II and IV was high in males while type I', III and V was high in females. Type I' was only present in 6 females (100%). Type I was not noted for this section for both gender. For the lower left section, males showed higher percentage of type II lip print pattern while type III, IV and V were high in females. Type V was noted in 2 females only. Type I was not found in this section for both gender.

Based on Table 5, gender could be suggested if lip print is found at a crime scene. For example, for the upper middle section, if type I' is the dominant lip print pattern,

female is the possible gender for the lip print, even though only 2 females had type I' in that section. Similar suggestion can be made if type I' is dominant in the upper right section where females dominates. For the lower right and left sections, females had higher percentage of having type V as the dominant lip print pattern. These findings could possibly be used in identification based on the lip prints.

The main objective of this study was to differentiate gender based on lip print pattern in Chinese population using lipstick-cellophane tape technique. The result showed that there was significant difference in all six sections of the lips between male and female, as noted by previous researches involving Malaysians (Durbakula et al. 2015; Neo et al. 2012; Nur Sabrina Sarah et al. 2019; Wan Rafiuddin et al. 2018). Durbakula (Durbakula et al. 2015) noted that type I' was dominant in Malaysians in all 4 quadrants while Neo (Neo et al. 2012) discovered that type I was the dominant lip print pattern in Malaysian Chinese in all 4 quadrants. Their results were different from the current study whereby type II was dominant in 4 sections: upper left, upper right, lower right and lower left sections while type IV was dominant in upper and lower middle sections, for Malaysian Chinese. All three projects used similar method: lipstick-cellophane tape technique for

TABLE 3: Percentage of lip print pattern distribution in each section between male and female

Types	Sections/ Sex	UL	UM	UR	LL	LM	LR
Type I	Male	1.5	0.0	1.5	0.0	0.0	0.0
	Female	3.8	0.0	3.8	0.0	0.0	0.0
Type I'	Male	1.0	0.0	0.0	0.5	0.0	0.0
	Female	4.8	1.0	3.3	0.5	2.9	0.0
Type II	Male	81.3	36.9	71.9	98.0	28.1	96.1
	Female	57.4	18.2	42.9	90.0	19.1	86.1
Type III	Male	2.0	3.9	5.9	0.5	3.0	1.5
	Female	16.7	25.8	28.7	5.7	16.3	9.6
Type IV	Male	12.3	56.2	18.7	1.0	62.6	2.5
	Female	12.9	50.7	18.2	1.9	50.2	2.9
Type V	Male	2.0	3.0	2.0	0.0	6.4	0.0
	Female	4.3	4.3	3.3	1.0	11.5	1.4

TABLE 4: Pearson chi-square test result

Section of lips	Significant value (<i>p</i>)
Upper left	$p < 0.05$
Upper middle	$p < 0.05$
Upper right	$p < 0.05$
Lower right	$p = 0.017$
Lower middle	$p < 0.05$
Lower left	$p = 0.001$

TABLE 5: Percentage of lip print pattern in different sections between male and female

Lip Section	Type	Frequency			Possible Gender
		Male	Female	Total	
UL	I	3	8	11	Female (72.7%)
	I'	2	10	12	Female (83.3%)
	II	165	120	285	Male (57.9%)
	III	4	35	39	Female (89.7%)
	IV	25	27	52	Female (51.9%)
UM	V	4	9	13	Female (69.2%)
	I'	0	2	2	Female (100.0%)
	II	75	38	113	Male (66.4%)
	III	8	54	62	Female (87.1%)
	IV	114	106	220	Male (51.8%)
UR	V	6	9	15	Female (60.0%)
	I	3	8	11	Female (72.7%)
	I'	0	7	7	Female (100.0%)
	II	146	89	235	Male (62.1%)
	III	12	60	72	Female (83.3%)
LR	IV	38	38	76	Both (50.0%)
	V	4	7	11	Female (63.6%)
	II	195	180	375	Male (52.0%)
	III	3	20	23	Female (86.9%)
	IV	5	6	11	Female (54.5%)
LM	V	0	3	3	Female (100.0%)
	I'	0	6	6	Female (100.0%)
	II	57	40	97	Male (58.8%)
	III	6	34	40	Female (85.0%)
	IV	127	105	232	Male (54.7%)
LL	V	13	24	37	Female (64.8%)
	I'	1	1	2	Both (50.0%)
	II	199	190	389	Male (51.2%)
	III	1	12	13	Female (92.3%)
	IV	2	4	6	Female (66.7%)
	V	0	2	2	Female (100.0%)

lifting the lip print, however, Durbakula and Neo had less than 50 subjects as compared to 412 subjects studied in the current study. Bindal (Bindal et al. 2009), Manipady (Manipady 2001-2002), Gondivkar (Gondivkar et al. 2009) and Wan Rafiuddin (Wan Rafiuddin et al. 2018) agreed that type II was the dominant lip print pattern, however, Bindal and Gondivkar explored the Indian population, while Wan Rafiuddin studied Malaysian Malays and Manipady's project involved both Indian and Chinese origin subjects. All of them however similarly used the lipstick-cellophane tape technique and Suzuki and Tsuchihashi classification.

CONCLUSION

This was the first research with bigger size sample for Malaysian Chinese population therefore the results could be useful for tentative identification process in forensic science. Therefore, careful assessment of lip print pattern can be suggested for gender differentiation among Malaysian Chinese population in Klang Valley. Further study should be conducted to validate these results. Using stereomicroscope instead of magnifying glass is recommended for better visual of the lip print.

ACKNOWLEDGEMENT

This study was fully funded by Faculty Health Sciences,

Universiti Kebangsaan Malaysia, project code GGPM-2017-064.

REFERENCES

- AbdelAziz, M.H., Badr ElDine, F.M.M. & Saeed, N.M.M. 2016. Regression equations for sex and population detection using the lip print pattern among Egyptian and Malaysian adult. *Journal of Forensic and Legal Medicine* 44: 103-110.
- Bindal, U., Jethani, S.L., Mehrotra, N., Rohatgi, R.K., Arora, M. & Sinha, P. 2009. Lip prints as a method of identification in human beings. *Journal of the Anatomical Society of India* 58(2): 152-155.
- Durbakula, K., Kulkarni, S., Prabhu, V., Jose, M. & Prabhu, R. 2015. Study and comparison of lip print patterns among Indian and Malaysian dental students. *Journal of Cranio-Maxillary Diseases* 4(1): 5.
- Eldomiatiy, M.A., Anwar, R.I. & Algaidi, S.A. 2014. Stability of lip-print patterns: a longitudinal study of Saudi females. *J Forensic Leg Med* 22: 154-158.
- Gondivkar, S., Indurkar, A., Degwekar, S. & Bhowate, R. 2009. Cheiloscopy for sex determination. *Journal of Forensic Dental Sciences* 1(2): 56-60.
- Ishaq, N., Malik, A.R., Ahmad, Z. & Ullah, S.E. 2018. Determination of sex by cheiloscopy as an aid to establish personal identity. *Annals of King Edward Medical University* 24(1).
- Kapoor, N. & Badiye, A. 2017. A study of distribution, sex differences and stability of lip print patterns in an Indian population. *Saudi Journal of Biological Sciences* 24(6): 1149-1154.
- Kasprzak, J. 1990. Possibilities of cheiloscopy. *Forensic Science International* 46(1): 145-151.
- Kautilya, D.V., Boddha, P. & Rajamohan, N. 2013. Efficacy of cheiloscopy in determination of sex among South Indians. *Journal of Clinical and Diagnostic Research : JCDR* 7(10): 2193-2196.
- Kinra, M., Ramalingam, K., Sethuraman, S., Rehman, F., Lalawat, G. & Pandey, A. 2014. Cheiloscopy for sex determination: A study. *Journal of Dentistry* 4(1): 48-51.
- Koneru, A., Surekha, R., Nellithady, G.S., Vanishree, M., Ramesh, D. & Patil, R.S. 2013. Comparison of lip prints in two different populations of India: Reflections based on a preliminary examination. *Journal of Forensic Dental Sciences* 5(1): 11-15.
- Kumar, A., Prasad, S.N., Kamal, V., Priya, S., Kumar, M. & Kumar, A. 2016. Importance of Cheiloscopy. *Int J Oral Care Res* 4(1): 48-52.
- Manipady, S. 2001-2002. A comparative study of lip print patterns among Indians and Chinese in Manipal (Dissertation, Manipal Academy of Higher Education, Manipal, India).
- Multani, S., Thombre, V., Thombre, A. & Surana, P. 2014. Assessment of lip print patterns and its use for personal identification among the populations of Rajnandgaon, Chhattisgarh, India. *J Int Soc Prev Community Dent* 4(3): 170-174.
- Nagrале, N., Bipinchandratirpude, Murkey, P. & Patond, S. 2014. Establishing cheiloscopy as a tool for identification: An assessment on 500 subjects in Central India. *Al Ameen Journal of Medical Sciences* 7(3): 201-206.
- Neo, X.X., Osman, K., Amir Hamzah, S.P.A. & Noor Hazfalinda, H. 2012. Lip prints in sex and race determination. *Jurnal Sains Kesihatan Malaysia* 10(1): 29-33.
- Nur Sabrina Sarah, A.R., Nur Hamizah, M.U., Gabriel, G.F. & Noor Hazfalinda, H. 2019. Digital approach for lip prints analysis in Malaysian Malay population (Klang Valley): Photograph on lipstick-cellophane tape technique. *Jurnal Sains Kesihatan Malaysia* 17(2): 43-49.
- Prabhu, R.V., Dinkar, A. & Prabhu, V. 2012. A study of lip print pattern in Goan dental students - A digital approach. *J Forensic Leg Med* 19(7): 390-395.
- Prabhu, R.V., Dinkar, A. & Prabhu, V. 2013. Digital method for lip print analysis: A New approach. *Journal of Forensic Dental Sciences* 5(2): 96-105.
- Ragab, A.R., El-Dakroory, S.A. & Rahman, R.H. 2013. Characteristic patterns of lip prints in Egyptian population sample at Dakahlia Governorate. *International Journal of Legal Medicine* 127(2): 521-527.
- Randhawa, K., Narang, R.S. & Arora, P.C. 2011. Study of the effect of age changes on lip print pattern and its reliability in sex determination. *J. Forensic Odontostomatol* 29(2): 45-51.
- Remya, S., Priyadarshini, T., Umadethan, B., Gopalan, M. & Jeyaseelan, N. 2016. Cheiloscopy – A study of lip prints for personal identification. *IOSR Journal of Dental and Medical Sciences* 15(2): 101-103.
- Santos, M. 1967. Queiloscopy - A supplementary stomatological means of identification. *International Microform J. Legal Medicine* 2.
- Saraswathi, T.R., Mishra, G. & Ranganathan, K. 2009. Study of lip prints. *J. Forensic Dent Sci* 1(1): 28-31.
- Shah, K.K. & Jayaraj, G. 2015. Cheiloscopy for sex determination among individuals aged 17-25 Years. *Journal of Pharmaceutical Sciences and Research* 7(9): 731-735.
- Sultana, Q., Shariff, M.H., Asif, M. & Avadhani, R. 2014. Cheiloscopy: A scientific approach for personal identification. *International Journal of Anatomy and Research* 2(4): 668-672.
- Thomas, C.J. & van Wyk, C.W. 1988. The palatal rugae in an identification. *J. Forensic Odontostomatol* 6(1): 21-27.
- Tsuchihashi, Y. 1974. Studies on personal identification by means of lip prints. *Forensic Science* 3: 233-248.
- Verghese, A. J., Somasekar, M. & Umesh Babu, R. 2010. A study on lip print types among the people

of Kerala. *Journal of Indian Academic of Forensic Medicine* 32(1): 6-7.

Wan Rafiuddin, W.A., Sri Pawita Albakri, A.H. & Noor Hazfalinda, H. 2018. Sex differentiation by lip print analysis in Malays: Lipstick-cellophane tape techniques. *ARC Journal of Forensic Science* 3(1): 18-21.

Noor Hazfalinda Hamzah,
Forensic Science Program,
Faculty of Health Sciences,
Universiti Kebangsaan Malaysia,
Jalan Raja Muda Abdul Aziz
50300 Kuala Lumpur, Malaysia.
Email : raviera@yahoo.com