InterViews: An Interdisciplinary Journal in Social Sciences
2024, Vol. 11, No. 1, pp. 71-79

ISSN: 2349-400X ©Saint Claret College, Ziro
https://doi.org/10.36061/IV.11.1.24.71.79

HISTOMORPHOLOGICAL DIFFERENCES OF HAIR AMONG COASTAL AND NON-COASTAL BENGALEE POPULATION OF WEST BENGAL

Soumyapratim Mandal[1] & Pranabesh Sarkar[2]

Hair is a thread-like biological material that regulates body temperature. It is made up of three regions like cuticle, cortex and medulla. However, variations of hair morphology in terms of hair shaft diameter and medullary diameter were found in different populations. Several studies have already been done in terms of morphological differences in hair between different populations as well as the same population living in different geographical regions. There is no such kind of work has been done previously on the hair morphology of the Bengalee population living in different geographical regions. Against this background, the objective of the study is to find out the histomorphological differences in hair between the Bengalee population of coastal and non-coastal areas of West Bengal. Four hundred scalp hairs were collected from fifty Bengalee male individuals living in the coastal region (Old Digha, Purba Medinipur) of West Bengal and fifty Bengalee male individuals living in non- coastal region (New Garia, Kolkata) of West Bengal. A high-resolution compound microscope (Coslab-STD-9LED) with a micrometre was used for the examination of hair. Descriptive and inferential (Mean, standard deviation, chi-square and T-test) statistics were performed using IBM SPSS (Version-20.0) software. The frequency of medulla was significantly ($p<0.05$) higher in the scalp hair of the Bengalee population living in the non-coastal area (25.5%) than in the Bengalee population living in the coastal area (15.5%). The medullary diameter and medullary

[1] *Soumyapratim Mandal* is a Post Graduate Student, School of Forensic Sciences, The West Bengal National University of Juridical Sciences, Salt Lake, Kolkata, India

[2] *Pranabesh Sarkar* is a Teaching Assistant, School of Forensic Sciences, The West Bengal National University of Juridical Sciences, Salt Lake, Kolkata, India. Correspondence regarding this article must be sent to: *p.sarkar1991@gmail.com*

index of hair strands of Bengalee people living in coastal areas was significantly ($p<0.05$) higher than Bengalee people residing in non-coastal areas. These findings might be incorporated as one of the criteria for the identification of Bengalee people living in Urban and costal areas of West Bengal.

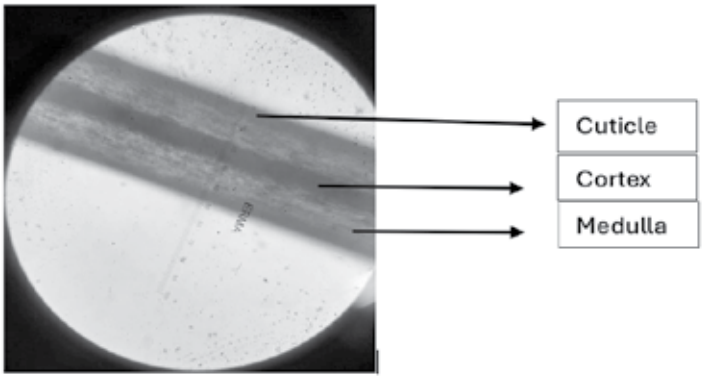
Keywords: Scalp hair, Hair morphology, Medullary index, Bengalee population

Introduction

Hair is a thread-like biological material mainly made of keratin protein. Keratin is a group of filament-forming and insoluble proteins. Hair is an important characteristic feature for all mammals that covers almost all of the body surface to regulate body temperatureexcept a few areas of the body, i.e., sole, palm, buccal surface of the lip, and portions of external genitalia (Buffoli et al., 2014). Human scalp hair is thicker (20–180 μm in width), longer (maximum length 90 cm approx.), and highly pigmented (Tobin, 2008). It is made up of three regions: cuticle, cortex and medulla (*Figure 1*). The cuticle is the outermost layer of hair. The main function of the cuticle is to protect the inner cortex and medulla of the hair through its tough inelastic protein content (Rogers, 2019). The cortex is the core of the hair shaft mainly made from a mix of proteins (mainly keratins) and natural pigments. The medulla is made up of some unorganized fibrillar materials, which can be microfibrils randomly located in the centre of the hair (Wagner, 2007). The medulla has been classified into four categories such as absent, discontinuous, continuous and fragmented. However, morphological variations of hair in terms of hair shaft diameter and medullary diameter were found in various populations (Das-Chaudhuri & Chopra, 1984; Tripathi et al., 2014; Gaur et al., 2007; Sarkar & Banerjee, 1956; Sen & Mondal, 2012; Chauhan et al., 2018; Jasuja & Minakshi, 2002; Banerjee, 1957) as well as same population living in different geographical region of India (Tripathi et al., 2014; Sen & Mondal, 2012; Singh & Sachdeva, 2018). These morphological variations of hair are caused due to genetic (Fujimoto et al., 2008; Koch et al., 2019) and environmental factors (pollution, lifestyle etc.) (Domzalski, 2004; Wu & Chen, 2010). Age is another important factor for changes in hair morphology through increased greyness of hairs (Baltenneck et al., 2022; Takahashi et al., 2015). Grey hair shaft diameter is comparatively thicker than black hair shaft diameter. Continuous medullation is mostly seen in grey hair compared to black hair (Mistry et al., 2010). Several studies have already been done in terms of morphological variation of hair between different populations as well as the same population living in different geographical regions (Das-Chaudhuri &

Chopra, 1984; Tripathi et al., 2014; Gaur et al., 2007). There has been no such kind of work done previously on the hair morphology of the Bengalee population living in different geographical regions. On this background, the objective of the study is to find out the histomorphological differences in hair between the Bengalee population of coastal and non-coastal areas of West Bengal.

Figure 1. Structure of Hair



Materials and Methods

The present study consisted of a hundred adult Bengalee male individuals (age range: 18-25 years). Within hundred adult Bengalee male individuals, fifty individuals residing in non- coastal region (New Garia, Kolkata) of West Bengal and fifty individuals residing in the coastal region (Old Digha, Purba Medinipur) of West Bengal. A purposive sampling method was used to select the participants. Four virgin scalp hair strands (without chemical and heat treatment) were collected from each participant of both regions through plucking. A total of two hundred hair strands were collected from each region. Written consent has been obtained prior to the collection of hair samples. After collection, hair strands were washed in carbon tetrachloride and mounted on a clean slide for microscopic observations. A high-resolution compound microscope (Coslab-STD-9LED) was used for the examination of hair. Hair strands were examined under 10X ocular and 0.40 mm objective resolution. Quantitative variables like shaft and medullary diameter measurements of hair have been obtained through a micrometer fitted with the microscope. Shaft diameter was measured at the root, middle points and tips of each of the hair and then the mean shaft diameter was taken. Similarly, the medullary diameter of hair was measured at three points of the medulla with a 0.5 mm gap and then the mean medullary diameter was taken. Medullary index (MI) was calculated by using the standard formula (MI = medullary diameter/ shaft

diameter). Descriptive and inferential (mean, standard deviation, chi-square and t-test) statistics were performed using IBM SPSS (Version 20) software. The cut-off was set as p=0.05.

Results

Our results indicate a significant difference ($p<0.05$) of medullation in scalp hair between the Non-coastal area and Coastal area. The frequency of medulla was significantly ($p<0.05$) higher in the scalp hair of the Bengalee population living in the non-coastal area (25.5%) than in the Bengalee population living in the coastal area (15.5%). (*Table 1, Figure 2*).

No significant differences ($p>0.05$) were found in Hair Shaft Diameter between Non-coastal area and Coastal area human scalp hair (*Table 2, Figure 3*).

The medullary diameter and medullary index of scalp hair of the Bengalee population living in coastal areas were significantly ($p<0.05$) higher than the Bengalee population residing in non-coastal areas. (*Table 3, Figure 4, Figure 5*).

Table 1: Distribution of medulla among coastal and non-coastal Bengalee population

Area	***No. of hair strands (N)***	***Medulla***	
		Present (%)	*Absent (%)*
Coastal	200	31 (15.5)	169 (84.5)
Non-Coastal	200	51 (25.5)	149 (74.5)

Table 2: Shaft diameter of scalp hair strands among coastal and non-coastal Bengalee population

Area	***No. of Hair strands (N)***	***Shaft Diameter (µm) (Mean ±SD)***
Coastal	200	41.92±6.37
Non-Coastal	200	41.29±6.88

Table 3: Medullary Diameter and medullary index of scalp hair among coastal and non-coastal Bengalee population

Area	***No. of Hair Strands (N)***	***Medullary Diameter (µm) (Mean± SD)***	***Medullary Index (Mean± SD)***
Coastal	31	7.462±1.97	0.161±0.40
Non-Coastal	51	5.712±2.02	0.125±0.04

Figure 2: Distribution of medulla among non-coastal and coastal Bengalee population

Figure 3: Shaft diameter of scalp hair strands among non-coastal and coastal Bengalee population

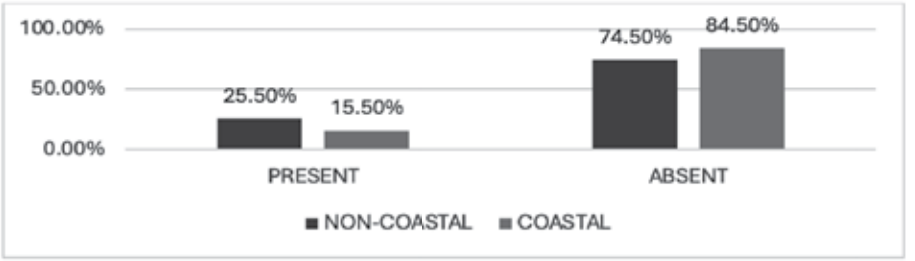
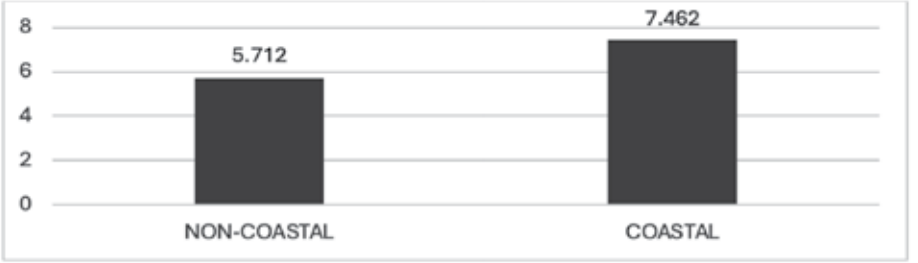


Figure 4: Medullary Diameter of scalp hair among non-coastal and coastal Bengalee population

Figure 5: Medullary index of scalp hair among non-coastal and coastal Bengalee population



Discussion

Hair is the most encountered trace evidence found in crime scenes. It helps to narrow down the number of suspects through histomorphological characteristics. In the present study, morphological differences of hair were observed among the Bengalee population living in different geographical regions. The higher incidence of medullation was found in the Bengalee population living in non-coastal areas (25.5%) compared to coastal areas (15.5%). However, histomorphological variation of hair has already been reported between different populations instead of the same population living in different geographical regions. A higher incidence of medullation was found in Onge males and females (Banerjee, 1957) compared to the Bengalee population. Similarly, the Punjabi population have a higher incidence of the medulla (32.54%) (Jasuja, & Minakshi, 2002) like Brahmins (34.92%) and Domars (32.84%) (Singh & Sachdeva, 2018).

There were no significant differences between the mean hair shaft diameter of the Bengalee population living in the coastal and non-coastal areas. But in comparison with other populations, hair shaft diameter was comparatively higher in the Brahmin and Domar population of Uttar Pradesh (Singh & Sachdeva, 2018) than in the Bengalee population living in two different geographical regions. On the other hand, the hair shaft diameter of Rajputs of Punjab was comparatively lower (Jasuja, & Minakshi, 2002) than studied population.

Hair medullary diameter was higher in the Bengalee population living in coastal areas (7.462μm) compared to people living in non-coastal areas (5.712μm). Similarly, the hair medullary index among the Bengalee populations living in the coastal area (0.161) was higher than people living in the non-coastal area of Bengal (0.125). These kinds of histomorphological differences occur due to sunlight, air pollution and wind (Chang et al., 2005). In comparison with other populations, hair medullary diameter was comparatively higher (7.28μm - 15.68μm) in Rajputs of Punjab (Jasuja, & Minakshi, 2002; Gaur et al., 2007), Brahmins (13.56μm) and Domars (12.59 μm) than Bengalee population living in coastal and non-coastal regions of Bengal (Singh & Sachdeva, 2018). On the other hand, the medullary index was comparatively higher(0.33) in the grey hair of the Bengalee population (Mistry et al., 2010) than the medullary index (0.31 – M, 0.28 – F) of black hair among the Domar population of Uttar Pradesh (Singh & Sachdeva, 2018).

Overall, the present study on histomorphological differences in hair between the Bengalee population living in urban areas and coastal areas indicates a higher incidence of medullation in the Bengalee population living in urban areas. On the other hand, medullary diameter and medullary index were higher in the Bengalee population living in coastal areas compared to non-coastal areas. These findings might be used as one of the criteria for the identification of Bengalee people living in Urban and coastal areas. Further studies involving a large number of participants may validate these results.

References

Baltenneck, F., Genty, G., Samra, E. B., Richena, M., Harland, D. P., Clerens, S., ... & Commo, S. (2022). Age-associated thin hair displays molecular, structural, and mechanical characteristic changes. *Journal of Structural Biology, 214*(4), 107908. https://doi.org/10.1016/j.jsb.2022.107908

Banerjee, A. R. (1957). Further histological studies on Negrito hair: The Onge of the Andaman Islands. *Man in India, 37*(3), 249–256.

Buffoli, B., Rinaldi, F., Labanca, M., Sorbellini, E., Trink, A., Guanziroli, E., ... & Rodella, L. F. (2014). The human hair: From anatomy to physiology. *International Journal of Dermatology, 53*(3), 331–341. https://doi.org/10.1111/ijd.12362

Chang, B. S., Hong, W. S., Lee, E., Yeo, S. M., Bang, I. S., Chung, Y. H., ... & Shin, D. H. (2005). Ultramicroscopic observations on morphological changes in hair during 25 years of weathering. *Forensic Science International, 151*(2–3), 193–200. https://doi.org/10.1016/j.forsciint.2004.12.037

Chauhan, A., Tyagi, N., & Shukla, S. (2018). A study on the presence of medulla types of hair among the young Jaat residents of Western Uttar Pradesh. *Journal of Forensic Sciences, 10*(4), 555795. https://doi.org/10.19080/JFSCI.2018.10.555795

Das-Chaudhuri, A. B., & Chopra, V. P. (1984). Variation in hair histological variables: Medulla and diameter. *Human Heredity, 34*(4), 217–221. https://doi.org/10.1159/000153613

De Cássia Comis Wagner, R. I. T. A., Kiyohara, P. K., Silveira, M., & Joekes, I. (2007). Electron microscopic observations of human hair medulla. *Journal of Microscopy, 226*(1), 54–63. https://doi.org/10.1111/j.1365-2818.2007.01750.x

Domzalski, A. C. (2004). The effects of environmental exposure on human scalp hair root morphology (Doctoral dissertation, John Jay College of Criminal Justice).

Fujimoto, A., Kimura, R., Ohashi, J., Omi, K., Yuliwulandari, R., Batubara, L., ... & Tokunaga, K. (2008). A scan for genetic determinants of human hair morphology: EDAR is associated with Asian hair thickness. *Human Molecular Genetics, 17*(6), 835–843. https://doi.org/10.1093/hmg/ddm343

Gaur, R., Angrish, I., & Bansal, S. R. (2007). Age, gender, and caste variations in scalp hair micro-morphological variables among Brahmins and Banias of Punjab, India. *Anthropologischer Anzeiger, 65*(2), 157–168. https://doi.org/10.1127/anthranz/2007/0021

Jasuja, O. P., & Minakshi. (2002). A study of variation in some morphological features of human hair. *Journal of Punjab Academy of Forensic Medicine and Toxicology, 2*, 1–6.

Koch, S. L., Shriver, M. D., & Jablonski, N. G. (2019). Variation in human hair ultrastructure among three biogeographic populations. *Journal of Structural Biology, 205*(1), 60–66. https://doi.org/10.1016/j.jsb.2018.12.003

Mistry, S., Ghosh, J. R., & Bandyopadhyay, A. R. (2010). Histomorphological and quantitative characteristics of black and grey human scalp hair. *Journal of Life Sciences, 2*(1), 49–52.

Rogers, G. E. (2019). Known and unknown features of hair cuticle structure: A brief review. *Cosmetics, 6*(2), 32. https://doi.org/10.3390/cosmetics6020032

Sarkar, S. S., & Banerjee, A. R. (1956). Histological difference between Negrito and Oraon hair. *Man in India, 36*(4), 288–291.

Sen, J., & Mondal, N. (2012). Hair diameter and medulla among the Rajbanshis of North Bengal. *The Oriental Anthropologist, 12*(1), 165–174.

Singh, R. K., & Sachdeva, M. (2018). Histomorphological comparison of human hair among Brahmins and Domars of Uttar Pradesh. *Academic Journal of Anthropological Studies, 1*, 49–57.

Takahashi, T., Mamada, A., Breakspear, S., Itou, T., & Tanji, N. (2015). Age-dependent changes in damage processes of hair cuticle. *Journal of Cosmetic Dermatology, 14*(1), 2–8. https://doi.org/10.1111/jocd.12110

Tobin, D. J. (2008). Human hair pigmentation–biological aspects. *International Journal of Cosmetic Science, 30*(4), 233–257. https://doi.org/10.1111/j.1468-2494.2008.00445.x

Tripathi, J., Mishra, M. K., Saran, V., & Gupta, A. K. (2014). Variation in morphological features of human head hair of different regions of India. *Journal of Forensic Science and Criminology, 2*(4), 403–411.

Wu, B., & Chen, T. (2010). Changes in hair arsenic concentration in a population exposed to heavy pollution: Follow-up investigation in Chenzhou City,

Hunan Province, Southern China. *Journal of Environmental Sciences, 22*(2), 283–286. https://doi.org/10.1016/S1001-0742(09)60103-1