



SOMATOSCOPIC DIVERSITY IN SKIN AND HAIR CHARACTERISTICS: A STUDY OF COLLEGE STUDENTS FROM PUNJAB AND MANIPUR

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Abstract: The study investigates somatoscopic diversity in skin colour, hair colour, and hair texture among college students from Punjab and Manipur, two regions of India with distinct genetic and ecological backgrounds. A total of 200 participants (100 from each region) were assessed under natural daylight using Luschan's skin colour chart (1897), Fischer-Saller hair colour scale (1951), and Martin-Saller hair texture classification (1957). Results revealed significant regional variation across all traits. In Punjab, skin pigmentation was distributed as 37% yellow-whitish, 50% brown, and 13% black, whereas Manipur showed 92% yellow-whitish, 8% brown, and 0% black ($\chi^2 = 66.86, p < 0.0001$). Hair colour in Punjab comprised 16% black, 39% light brown, and 45% dark brown, while Manipur exhibited 26% black, 16% light brown, and 58% dark brown ($\chi^2 = 13.64, p = 0.0011$). Hair texture analysis highlighted the strongest divergence: Punjab showed 67% wavy, 33% straight, and 8% curly hair, whereas Manipur was dominated by 83% straight, 10% curly, and 7% wavy hair ($\chi^2 = 70.22, p < 0.0001$). These statistically validated differences reflect genuine biological divergence shaped by ancestry and environment. The findings underscore the anthropological relevance of somatoscopic traits in documenting population diversity and highlight their forensic utility in biological profiling, population attribution, and identification accuracy.

Keywords: Somatoscopy; Skin colour, Hair colour, Hair texture, Population variations

I. INTRODUCTION

Somatoscopic traits such as skin tone, hair colour, and hair texture visibly reflect human biological diversity. While primarily determined by genetic inheritance, they are also influenced by environmental factors including climate, UV exposure, altitude, and cultural practices.” (Jablonski & Chaplin, 2010;

Relethford, 2009). The study of such external features provides important insight into population variation, evolutionary adaptation, and regional differentiation among human groups (Frost, 2005). India is characterized by exceptional biological and ethnic diversity, resulting from complex patterns of migration, admixture, and geographical isolation (Basu et al., 2003; Reich et al., 2009). Populations inhabiting different regions exhibit distinct somatoscopic profiles influenced by both ancestry and environment. Punjab, situated in the northwestern plains of India, is predominantly inhabited by Indo-Aryan populations (Thapar, 2004), whereas Manipur, located in the northeastern hill region, is largely home to Tibeto-Burman ethnic groups (Singh, 2011). The contrasting ecological settings and genetic backgrounds of these regions make them suitable for comparative analysis of external phenotypic traits. Young adult populations, such as college students, provide an appropriate sample for somatoscopic studies as age-related changes in skin and hair are minimal, allowing clearer observation of inherited characteristics (Bhattacharya et al., 2015). Systematic documentation of skin colour and hair attributes in such groups contributes to a better understanding of regional biological variation (Majumder, 1998). In addition to their anthropological significance, somatoscopic traits play an important role in forensic anthropology. Visible characteristics such as skin tone and hair morphology assist in constructing the biological profile of unknown individuals during medico-legal investigations (Krogman & İşcan, 1986; Christensen et al., 2014). Region-specific data on external traits improve the accuracy of population attribution and support forensic identification processes in a country as diverse as India (Sankhyan, 2016). Therefore, the present study aims to document and compare somatoscopic variations in skin and hair characteristics among college students from Punjab and Manipur, contributing both to anthropological knowledge and forensic applications.

II. MATERIAL AND METHODS

The present study was conducted among groups of college (Dolphin PG College Chunni Kalan , Faethgarh Sahib, Punjab) students from Punjab and Manipur. Data were collected through random observation of these student groups, with a total of 200 samples obtained, 100 from Punjab and 100 from Manipur. In each State group, the sample comprised 50 males and 50 females, ensuring balanced gender representation. The somatoscopic parameters studied included hair on the head (colour and form) and skin colour. Written consent was obtained from each participant prior to inclusion in the study.

Skin pigmentation varies across body regions depending on sunlight exposure, with consistently lighter tones in less exposed areas. Skin exposed to sunlight tends to be darker than those not exposed. Different portions of the body show different skin colour, out of which a few parts are usually taken into consideration, such as, the forehead, chest, shoulder blade and inner side of the upper arm.

The skin colour observed is been compared to the standard colour scale, the Luschan's skin color chart (1897) that is distinguished by 36 degrees of colour on a scale of 1-36. Hair colour is the result of the mixing ratio of two types of melanin that occurs, namely blackish eumelanin and yellowish pheomelanin. Hair colour evaluation is been done based on Fischer-Saller Scale (1951). It is A: blonde, B-E: light blonde (straw), F-L: blonde, M O: dark blonde, P-T: light brown to brown, U-Y: dark brown

to black, I-IV: reddish, V-VI: reddish blonde. Hair texture has been classified according to Martin and Saller (1957), has categorized into varieties, i.e. straight, sleek, flat waved, broad waved, narrow waved, curly, frizzly, widely knit, closely knit, peppercorn, spiral (Iohman et al., 1998).

III. RESULT AND DISCUSSION

SKIN COLOUR

The present study highlights significant somatoscopic diversity in skin colour, hair colour, and hair texture between college students from Punjab and Manipur, reflecting both genetic inheritance and ecological influences. From each state, 100 individuals were selected, comprising 50 males and 50 females. In Punjab, the distribution of skin colour revealed that 37% of participants (19 males, 18 females) exhibited yellow-whitish pigmentation, 50% (25 males, 25 females) were brown, and 13% (6 males, 7 females) were black (Table.1)

Table 1: Somatoscopic observation of skin colour of students belongs to Punjab and Manipur

Skin Colour	PUNJAB (N=100)		Total percentage	MANIPUR (N=100)		Total Percentage
	Male	Female		Male	Female	
Yellow Whitish	19	18	37%	45	47	92%
Brown	25	25	50%	5	3	8%
Black	13	7	20%	0	0	0%

In contrast, Manipur demonstrated a markedly different profile, with 92% (45 males, 47 females) showing yellow-whitish pigmentation, 8% (5 males, 3 females) brown, and no individuals presenting black pigmentation. The chi-square test confirmed that these differences were statistically significant ($\chi^2 = 66.86$, $p < 0.0001$), indicating that the variation in skin colour distribution between Punjab and Manipur is not due to chance. These findings align with earlier observations that regional variation in pigmentation is shaped by ancestry and environmental adaptation, particularly UV exposure and altitude (Jablonski & Chaplin, 2010; Relethford, 2009). These findings highlight clear regional variation: Punjab demonstrates a balanced distribution across all three categories, whereas Manipur is characterized by a strong dominance of yellow-whitish tones and complete absence of black pigmentation.

HAIR COLOUR

The distribution revealed (Table. 2) that 16% of participants (6 males, 10 females) exhibited black pigmentation, 39% (21 males, 18 females) were light brown, and 45% (23 males, 22 females) were dark brown. In contrast, Manipur demonstrated a different profile, with 26% (12 males, 14 females) showing black pigmentation, 16% (8 males, 8 females) light brown, and a majority of 58% (30 males, 28 females) dark brown. These results corroborate earlier genetic studies that emphasize the role of melanin variation and admixture in shaping hair pigmentation across Indian populations (Basu et al., 2003; Reich et al., 2009). The chi-square test ($\chi^2 = 13.64$, $df = 2$, $p = 0.0011$) confirmed significant differences, reinforcing the influence of ancestry and ecological background.

Table 2: Somatoscopic observation of Hair colour of students belongs to Punjab and Manipur

Skin Colour	PUNJAB (N=100)		Total percentage	MANIPUR (N=100)		Total Percentage
	Male	Female		Male	Female	
Black	6	10	16%	12	14	26%
Light Brown	21	18	39%	8	8	16%
Dark Brown	23	22	45%	30	28	58%

Table 3: Somatoscopic observation of type of hairs of students belongs to Punjab and Manipur

Skin Colour	PUNJAB (N=100)		Total percentage	MANIPUR (N=100)		Total Percentage
	Male	Female		Male	Female	
Straight Hairs	15	18	33%	38	45	83%
Curly Hairs	3	5	8%	7	3	10%
Wavy Hairs	32	35	67%	5	2	7%

HAIR TEXTURE

Hair texture analysis revealed the most striking divergence (Table3). In Punjab, wavy hair predominated (67%), followed by straight (33%) and curly (8%). In contrast, Manipur was overwhelmingly characterized by straight hair (83%), with curly (10%) and wavy (7%) types being rare. These findings resonate with ethnographic accounts of Indo-Aryan and Tibeto-Burman populations, where hair morphology serves as a visible marker of genetic differentiation (Singh, 2011; Bhattacharya et al., 2015). Statistical evaluation confirmed a highly significant difference ($\chi^2 = 70.22$, $df = 2$, $p < 0.0001$), indicating that hair texture is a robust somatoscopic trait for distinguishing regional populations.

From a forensic perspective, these results underscore the importance of documenting region-specific external traits. Somatoscopic features such as skin tone and hair morphology contribute to constructing biological profiles in medico-legal investigations (Krogman & İşcan, 1986; Christensen et al., 2014). The observed divergence between Punjab and Manipur strengthens the forensic utility of these traits, supporting population attribution and enhancing identification accuracy in a country marked by exceptional biological diversity (Majumder, 1998; Sankhyan, 2016)

IV. CONCLUSION

This study establishes that somatoscopic traits such as skin colour, hair colour, and hair texture vary significantly between Punjab and Manipur populations, with Punjab showing a balanced distribution of pigmentation and predominance of wavy hair, while Manipur is characterized by overwhelming yellow-whitish skin tones, dark brown pigmentation, and straight hair morphology. The chi-square analyses confirmed that these differences are statistically significant, reflecting genuine biological divergence shaped by ancestry and ecological adaptation. From a forensic perspective, these findings are highly relevant as region-specific documentation of external traits enhances biological profiling and strengthens identification accuracy in medico-legal investigations, particularly in diverse populations where conventional biometric evidence may be limited.

Looking ahead, future studies should expand the sample size to include multiple states and ethnic groups across India, thereby improving statistical strength and generalizability. Incorporating genetic analysis alongside somatoscopic traits would provide deeper insights into hereditary influences, while longitudinal studies could explore the impact of environmental factors such as climate and lifestyle on pigmentation and hair morphology. Developing standardized forensic databases of somatoscopic traits would further enhance their practical application in casework, supporting population attribution and forensic anthropology. This research contributes valuable baseline data to both anthropology and forensic science, while future work should focus on broader sampling, genetic correlation, and forensic application models. Such efforts will strengthen the reliability of somatoscopic traits as markers of regional variation and reinforce their importance in forensic identification frameworks.

V. REFERENCES

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