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Original Research Article

Appraisal of Skin Color by Dint of RGB Values in Perceiving *Prakriti* of Infants

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ABSTRACT

Background and Aim: Prakriti is one of the unique and basic concepts of Ayurveda that explain the individuality, which is decided at the time of conception and later nourished during the intrauterine life. There are so many factors that influence the Prakriti of an infant, one of them is skin color. As par Ayurveda, Vata Prakriti individuals present Dhusaragatra (dusky color body), Pitta Prakriti persons show Tamra Varna (coppery color), while Kapha Prakriti individuals express Durva, Priyangu and Sarkanda color.

Methods: Prakriti of 226 infants was assessed thru PRS-IPA (Prototype Research Software-Infant Prakriti Assessment), a Prakriti assessment software for infants, while the RGB values were gathered from facial photographs of healthy infants of different Prakriti as well as from photographs of Tamra (copper sheet), Durva (Cynodon dactylon), Priyangu (Callicarpa macrophylla) and Sarkanda, (Saccharum bengalense) through MATLAB R 3013b software.

Discussion & Conclusion: In present study, the R, G, B, and RGB values have shown significant variation between two Prakriti pairs among the infants of various Prakriti (n=226). Mean values of Red, Green, Blue component, and RGB for three basic Prakriti were respectively 101.96 ± 5.62, 63.31 ± 4.61, 44.08 ± 7.53 and 209.35 ± 8.67 for Vata Prakriti infants while these were 138.77± 7.79, 92.87± 9.12, 68.42± 6.95, and 300.07 ± 16.04 for Pitta Prakriti and for Kapha Prakriti infants, these values were 240.88 ± 7.1, 151.86 ± 14.55, 90.99± 10 and 483.74±17.22 respectively. These values suggest that Kapha Prakriti individuals have maximum RGB value, while Pitta and Vata Prakriti individuals have medium and minimum RGB values respectively. The present study exhibits strong relation between the range of R, G, B and cumulative RGB values with Prakriti of infants.

Key Words: - Prakriti, Infants, RGB (Red, Green & Blue), PRS-IPA (Prototype Research Software-Infant Prakriti Assessment)

INTRODUCTION

The word *Prakriti* is found in various branches of Indian literature like *Veda*, *Upanishada*, *Ramayana*, *Mahabharata*, *Purana*, *Samhita* and other innumerable references. In *Ayurveda* seven broad constitutions (*Prakriti*) have been described. [1] One or more than one *Dosha* predominates at the time of conception which reflects the *Doshika Prakriti* of an individual and can be identified by *Dosha* specific characteristics manifested in growing individual. [1] *Prakriti* is enumeration of body features; internal as well as external. [2] Six *Bhava* (component) viz. *Matrija*, *Pitrija*, *Rasaja*, *Satvaja*, *Satmyaja*, and *Atmaja* are responsible for the growth and development of a fetus, and can be considered as determinants for the development of organs and *Prakriti*. [3,4]

Prakriti helps in diagnosis, [5] management of disease [6] by assessing *Bala* (strength) of a patient, and forecast the proneness of *Dosha* dependent disorders in future. [7] Knowledge of *Prakriti* can direct the parents also for anticipation [8] of probable disorders and also helps in making right decision for career of their wards at a very early age. [9] *Prakriti* in infants plays a very important role in deciding diagnosis, therapeutics and prognosis. [10] *Prakriti* of a newborn or children can lead to inculcation and execution of such lifestyles that will result in prevention of chronic diseases and more healthy high quality life for an individual. [11]

Concept of colour has very significant place in *Ayurveda*. Colour of skin, eye, tongue, hairs, urine, stool etc. has important role in making diagnosis, in turns planning of treatment. Alteration in colours of these body parts indicates various disorders. As far as *Prakriti* is concerned *Vata Prakriti* individuals have *Dhusara Gatra* [12] (dust or grey color body) and *Krishna Varna* [13] (blackish skin), while in *Pitta Prakriti Tamra Varna* [14] (coppery color) of the body has been stated. Among *Kapha Prakriti* individuals, the body colour may be like *Durva*, *Priyangu*, *Arishtaka* or *Sarakanda*. [15]

These colours resemblance with the human skin play a significant role for the assessment of *Prakriti*. To assess variation in skin colour of individuals is difficult by subjective method. Therefore, to make the assessment of *Prakriti* more scientific, reliable and valid, a scientific tool was used. In other words, RGB values of predefined part of face photograph was evaluated to make the skin colour more perceptible, and to minimize the human error. So, the rationale of this study is to explore a relation between RGB value of skin and *Prakriti* of infants.

MATERIALS AND METHODS

Selection of Patients

For this cross-sectional study, total 226 infants were registered on 10th day of life from the *Kaumarbhritya* /*Balroga*, O.P.D., S.S. Hospital, I.M.S, B.H.U after obtaining approval from the institutional ethical committee, letter number-dean/2011-12/392-A dated on 12/12/2011. The subjects were selected using simple random sampling and written informed consent after offering adequate details about the study and its endeavor. *Prakriti* assessment in every infant was done thru a predesigned software i.e. PRS-IPA (Prototype Research Software-Infant *Prakriti* Assessment). [9] The following criteria were considered for the selection of cases -

Inclusion Criteria

1) Infants, whose parents have given written informed consent for the participation in the study
2) Ten days old, FT (AGA), healthy newborn babies, who were delivered by uncomplicated SVD and elective lower segment cesarean section (LSCS) without showing any sign of fetal distress.

Exclusion Criteria

Newborn baby, if having any one of the following conditions, was excluded from the study -

1) Whose parents were not willing to participate in the study.
2) Preterm, post term or full term (SGA/LGA) baby at registration.
3) Any associated congenital anomalies at registration.
4) Infant who was suffering with any disease at registration or any life-threatening disorder observed on subsequent follow ups.

Assessment of Prakriti-

For this study, a questionnaire was prepared on the basis of *Prakriti* characteristic mentioned in different textbooks of Ayurveda viz. *Charaka Samhita*, [16] *Sushruta Samhita*, [17] *Ashtanga Samgraha*, [18] *Ashtanga Hridya*, [19] *Bhava*

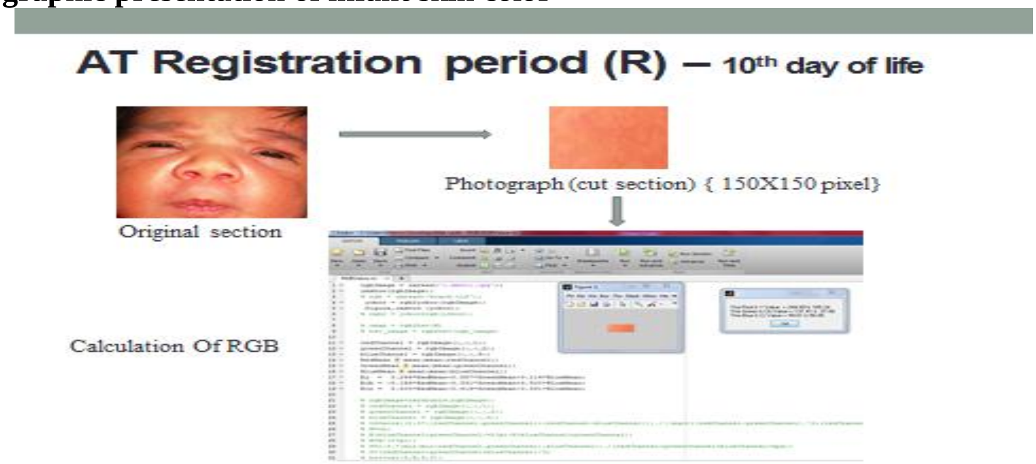
Prakasha, [20] *Sharangadhar Samhita*, [21] *Harita Samhita*, [22] *Bhela Samhita* [23] and *Kashyapa Samhita*. In questionnaire, only those *Doshika* characteristics were taken, which were related to infants; while other characteristics related to the adults were not considered. Assessment was made by analyzing amassed data from the filled questionnaire and physical examination of infants. All the concerned characteristics were assessed by *Trividha Pariksha* in Ayurveda as *Darshan* (visual) *Sparshana* (tactile) examination and *Prashna* (question). Determination of *Prakriti* was done by giving 100% to sum of all the *Prakriti* characteristics irrespective to the number of characteristics described in Ayurveda for the particular *Prakriti* type. [24]

Assessment of RGB Score-

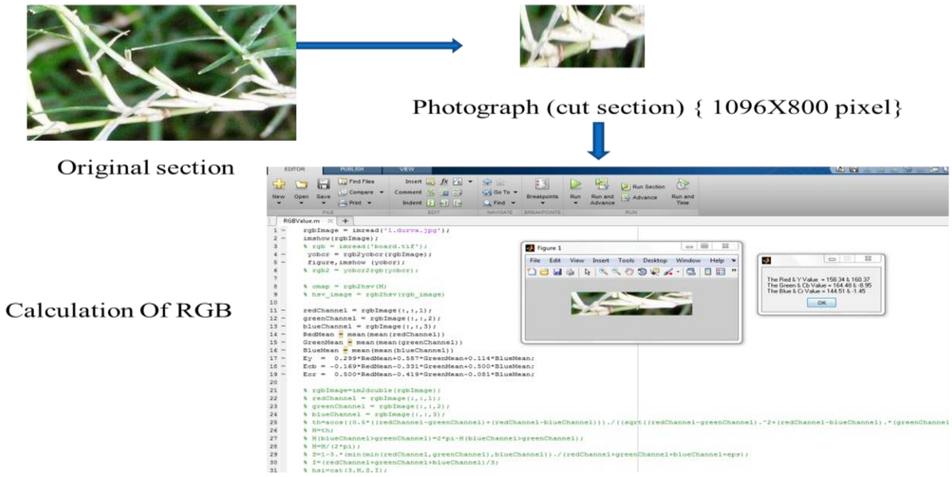
Assessment of RGB color score of *Durva, Sarkanda, Priyangu, Tamra* (copper) was done as these colors are described as reference skin color for *Kapha Prakriti* [25] and *Pitta Prakriti* [26] individuals in Ayurveda: RGB color assessment was done by MATLAB R 3013b software as per following method-

1) Frontal JPEG image of infant was taken by Sony Camera (Sony Handycam ABCHDHDD series HRDXR550 with focal length-3.8 mm, focal number - F/1.8, exposure time 1/25 sec and without flash.
2) At the time of taking face image, room light, distance between baby and camera was fixed in each case as per the protocol of photography adopted for research work.
3) A crop-section of 150 x 150 pixels from the selected JPEG image was taken from the prominent part of right cheek region of infant, below the right eye and lateral to the philtrum.
4) Icon of MATLAB R 2013 b software displayed on taskbar of desktop was opened. The crop-section of JPEG image file was renamed and inserted in MAT- code RGB folder, which was appeared on desktop at the time of installation of MATLAB R2013 b software.
5) Then MATLAB R 2013 b software was opened. Further RGB value file was opened → RGB value in file will be opened. In line 1[rgbImage = imread('.jpg');] insert the given 'name' of JPG image-file in between ' and .jpg 'Run' button, given in ribbon of the opened page, was clicked. The values of the Red, Green, and Blue color were displayed in a separate window in addition to figure window. Three cut sections were taken in each baby for the RGB value. The mean value of these three data was taken as a final data of RGB for the study.

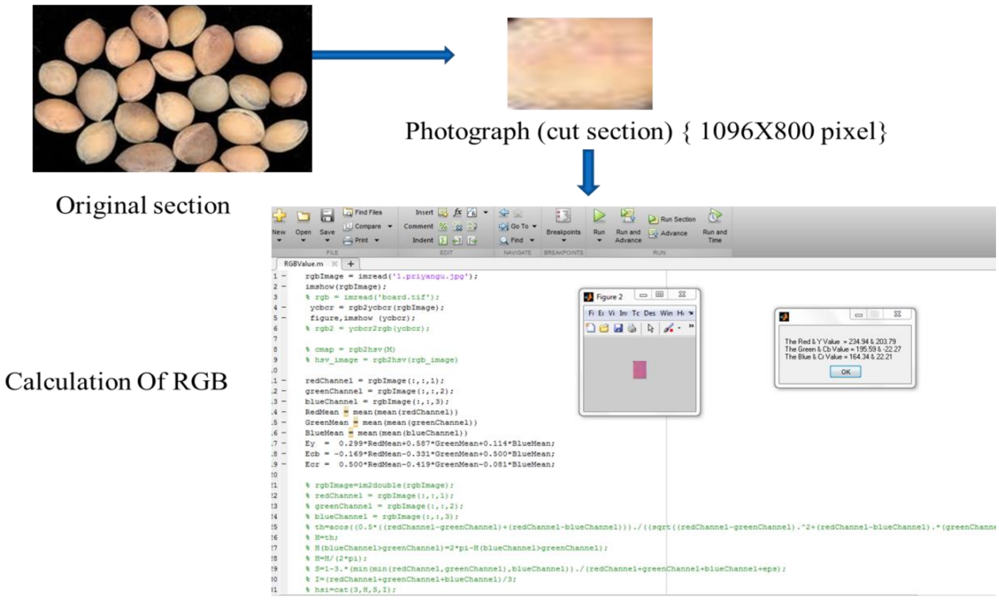
Photographic presentation of infant skin color -



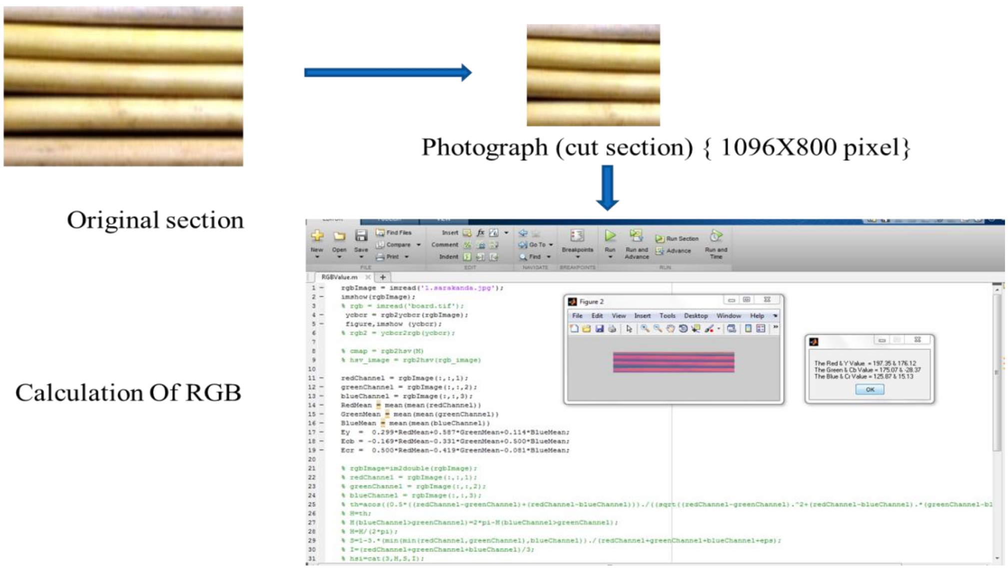
RGB Score of Durva Grass- (*Cynodon dactylon*)

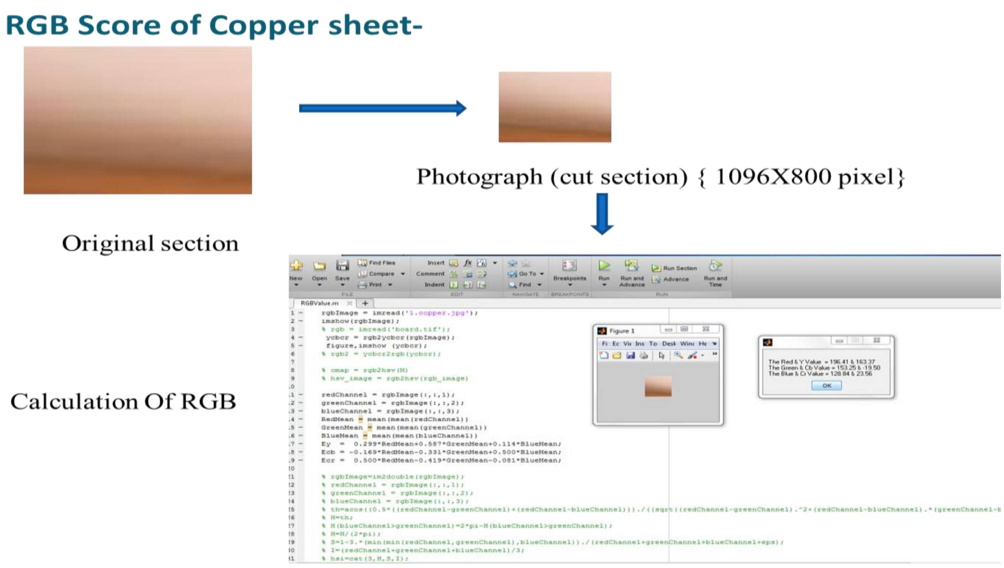


RGB Score of Priyangu - (*Callicarpa macrophylla*)



RGB Score of Sarakanda Plant - (*Saccharum bengalense*)





Algorithm for calculation of RGB value:-

1. Input: Initialize the input face image with size m × n pixel, where m, n = 500
2. Resize and crop the face image (I) into p × q pixel (where p=150 and q = 150)
3. Split RGB image into three separate grey scale image (I) representing the red (R), green (G), blue (B) color as follows:
   Image_red (R) = Image_rgb (:,1);
   Image_green (G) = Image_rgb (, 2);
   Image_blue (B) = Image_rgb (:,3);
4. Calculate the average of Red (R), Green (G) and Blue (B) of face image (I) as follows:
   Average = 1/3*(R+G+B); Output: return Average

All the measurements were done in *Prakriti-Vikriti* assessment lab in Kaumarbhritya /BalRoga OPD of S.S hospital, Indian medicine wing, BHU Varanasi.

Statistical analysis of data:-

The obtained RGB data, as per the *Prakriti of* infants, were categorized, and statistical analysis was done to find out relationship of RGB data with the attained *Prakriti*.

The analyzed data have been presented as values of mean ± standard deviation of mean (Min – Max), One Way ANOVA test, and Post-Hoc pairs (Bonferroni tests) values between different *Prakriti*. The statistical analysis of data was performed by using (IBM SPSS) statistics software version 22.0.

Observations and results: -

Prakriti of registered infants was assessed and its relation was explored in context to RGB data.

Table No. 1 Showing relation between Red, Green, Blue and total RGB score of infant's skin color in different *Prakriti* at registration (10th day of life)

Prakriti (n=226)	Red	Green	Blue	RGB
	Mean ± SD (Min – Max)	Mean ± SD (Min – Max)	Mean ± SD (Min – Max)	Mean ± SD (Min – Max)
I. *Vata* (n=5)	101.96 ± 5.62 (94, 107.5)	63.31 ± 4.61 (57.89, 70.56)	44.08 ± 7.53 (37.12, 53.24)	209.35 ± 8.67 (199.32, 223.1)
II. *Pitta* (n=27)	138.77± 7.79 (121.2, 150.2)	92.87 ± 9.12 (71.2, 107.6)	68.42± 6.95 (55.12, 78.3)	300.07 ± 16.04 (265.12, 330.36)
III. *Kapha* (n=31)	240.88 ± 7.1 (225.8, 251.89)	151.86 ± 14.55 (117.5, 177.8)	90.99 ± 10 (71.12, 112.4)	483.74 ± 17.22 (446.19, 509.25)
IV. *Vata-Pitta* (n=48)	104.68 ± 16.25 (78.9, 137.1)	69.41 ± 11.79 (50.1, 98.8)	61.13 ± 9.42 (42, 78.3)	235.23 ± 30.2 (180.9, 307)
V. *Vata-Kapha*(n=53)	169.6 ± 63.05 (87.25, 254.1)	105.52 ± 33.94 (51.1, 165.4)	77.06 ± 18.3 (40.1, 110.1)	352.2 ± 104.88 (191, 503.15)
VI. *Pitta Kapha*(n=62)	185.38 ± 44 (121.3, 245)	110.27 ± 24.09 (76.5, 162.7)	79 ± 11.24 (50.5, 98.1)	374.66 ± 71.13 (258.5, 502.1)

Table1 to be Continued…

One Way ANOVA	F = 54.065 p = 0.000 HS	F = 56.725 p = 0.000 HS	F = 31.540 p = 0.000 HS	F = 64.496 p = 0.000 HS
Post-Hoc pairs Bonferroni tests	I vs III (p=0.000 HS) I vs V (p=0.004 HS) I vs VI (p=0.000 HS) II vs III (p=0.000 HS) II vs IV (p=0.006 HS) II vs V (p=0.016 HS) II vs VI (p=0.000 HS) III vs IV (p=0.000 HS) III vs V (p=0.000 HS) III vs VI (p=0.000 HS) IV vs V (p=0.000 HS) IV vs VI (p=0.000 HS)	I vs III (p=0.000 HS) I vs V (p=0.001 HS) I vs VI (p=0.000 HS) II vs III (p=0.000 HS) II vs IV (p=0.000 HS) III vs IV (p=0.000 HS) III vs V (p=0.000 HS) III vs VI (p=0.000 HS) IV vs V (p=0.000 HS) IV vs VI (p=0.000 HS)	I vs III (p=0.000 HS) I vs V (p=0.001 HS) I vs VI (p=0.000 HS) II vs III (p=0.000 HS) II vs IV (p=0.000 HS) II vs VI (p=0.013 HS) III vs IV (p=0.000 HS) III vs V (p=0.000 HS) III vs VI (p=0.000 HS) IV vs V (p=0.000 HS) IV vs VI (p=0.000 HS)	I vs III (p=0.000 HS) I vs V (p=0.000 HS) I vs VI (p=0.000 HS) II vs III (p=0.000 HS) II vs IV (p=0.001 HS) II vs V (p=0.013 HS) II vs VI (p=0.000 HS) III vs IV (p=0.000 HS) III vs V (p=0.000 HS) III vs VI (p=0.000 HS) IV vs V (p=0.000 HS) IV vs VI (p=0.000 HS)

Data of table no.01 reveals that maximum Red (240.88 ± 7.1), Green (151.86 ± 14.55), Blue (90.99 ± 10), total (RGB) (483.74 ± 17.22) scores of infants were seen in *Kapha Prakriti* infants while minimum Red (101.96 ± 5.62), Green (63.31 ± 4.61), Blue (44.08 ± 7.53) and total RGB (209.35 ± 8.67) scores were observed in *Vata Prakriti*. One way ANOVA test showed significant variations in all these scores (p value < 0.001). On applying Post Hoc Bonferroni Test, these scores were found significant in almost all the pairs (p< 0.001).

Table No. 2 RGB score reference of *Durva, Sarakanda*, *Priyangu* and *Tamra* along with Infant's skin of *Kapha-Prakriti*, and *Pitta Prakriti*-

Reference Plant / Infant Skin	Red	Green	Blue	RGB
	Mean ± SD (Min – Max)	Mean ± SD (Min – Max)	Mean ± SD (Min – Max)	Mean ± SD (Min – Max)
1. Durva	157.82±1.88 (155.45,159.98)	163.63±2.33 (161.45,166.54)	144.42±2.59 (141.65,147.87)	465.89±5.30 (459.17,471.95)
2. Sarkanda	190.78±2.32 (187.88,193.54)	168.04±1.85 (165.64,170.12)	124.93±1.63 (122.65,126.24)	481.75±4.76 (468.17,483.63)
3. Priyangu	247.73±1.42 (245.67,248.92)	204.81±3.22 (201.07,208.65)	159.72±6.47 (151.93,166.08)	501.34 ± 4.76 (479.17,508.61)
4. Tamra	177.3±8.49 (167.36,186.82)	86.1 ± 6.34 (78.34,92.77)	90.32 ± 6.79 (81.78,96.23)	345.89±3.39 (289.17,361.95)
5. Infant (Kapha-Prakriti)	240.88 ± 7.1 (225.8, 251.89)	151.86 ± 14.55 (117.5, 177.8)	90.99 ± 10 (71.12, 112.4)	483.74 ± 17.22 (446.19,509.25)
6. Infant : (Pitta-Prakriti)	138.77± 7.79 (121.2, 150.2)	92.87 ± 9.12 (71.2, 107.6)	68.42± 6.95 (55.12, 78.3)	300.07 ± 16.04 (265.12, 330.36)
7. Infant: (Vata-Prakriti)	101.96 ± 5.62 (94, 107.5)	63.31 ± 4.61 (57.89, 70.56)	44.08 ± 7.53 (37.12, 53.24)	209.35 ± 8.67 (199.32, 223.1)

DISCUSSION

The present study shows that R, G, B, and RGB values have significant variation in between two *Prakriti* pairs among the various *Prakriti* of infants. For instance, mean values of Red, Green, Blue component, and RGB for three basic *Prakriti* are 101.96 ± 5.62, 63.31 ± 4.61, 44.08 ± 7.53, and 209.35 ± 8.67 respectively for *Vata Prakriti* while for *Pitta Prakriti* infants, these values are 138.77± 7.79, 92.87± 9.12, 68.42± 6.95, and 300.07 ± 16.04; and for *Kapha Prakriti* infants are 240.88 ± 7.1, 151.86 ± 14.55, 90.99± 10 and 483.74±17.22. The values of R, G, B, and RGB for other *Prakriti* types infants fall in between these three *Prakriti* values. In this study R, G, B and total RGB value of *Kaphaja Prakriti* individual's skin is very close to RGB score of *Sarkanda* plant and RGB score of *Pittaja Prakriti* individual's skin is also close to RGB score of *Tamra* plate. The trend of RGB values are found in accordance to complexion i.e. the RGB value increases with increase in fair complexion and decreases with increase in dark complexion. [27]

This study suggests that result of RGB values is significant in respect to *Prakriti*, means a clear cut relation and range between Red, Green and Blue values and *Prakriti* are seen. *Kapha Prakriti* individuals are having maximum RGB value, *Pitta* and *Vata Prakriti* individuals are having medium and minimum RGB values. This study also validates the concept of colour mentioned in Ayurvedic texts.

Tripathi P.K. et al (2016) [28] have also reported similar trend of RGB values as per *Prakriti* in healthy adults. Another study by Agarwal S. et al (2017) [29,30] have also reported minimum RGB values in *Vata Prakriti* individuals but maximum value of RGB was reported in *Pitta Prakriti* individuals then with slight variation in *Kapha Prakriti* individuals. This variation in RGB values might be due to slight difference in methodology because in this study whole face is considered for the calculation of RGB value while in study by Tripathi P.K. et al (2016) five prominent points of face have been considered for the calculation of RGB value. Being a preliminary work in infant skin, we are not able to compare these results because no research work related to infant skin and RGB values is available. Present study can be a lead for a future study having a large sample size. After confirming result on large sample size, findings can be used in a reverse manner also means if we know the RGB values of facial photograph of an individual then based on these values, we can predict his/her *Prakriti* i.e. It can be used as a tool for determination and identification of infant *Prakriti*.

CONCLUSION

In this cross sectional study, the colour variation with the human skin may play a significant role for the assessment of *Prakriti*. Assessment of skin colour by photographs through RGB values calculated by MATLAB R 3013b software is an important objective parameter. Significant change in RGB value is observed as per *Prakriti*, i.e. a clear cut relation and range between Red, Green and Blue values and *Prakriti* are seen. *Kapha Prakriti* individuals are having maximum RGB value, *Pitta* and *Vata Prakriti* individuals are having medium and minimum RGB values.

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