

## Novel Scientific Assessment Scale

# Multiparametric composite glow and radiance scale: an objective, scientific assessment tool for skin glow and radiance evaluation

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### ABSTRACT

There are numerous instruments available to assess pigmentation in terms of color, melanin, and other factors, but there is no standardized or validated tool to assess a person's glow and radiance. The MSCR- glow and radiance index (G&R)-composite scale was created with the help of a bio-physics background and includes five important factors. The scale is intended to provide an objective, scientific assessment tool for a highly subjective perception caused by numerous skin features. It should be emphasized that the scale is highly sensitive in measuring minor changes in the skin and generating numerical data that can be assessed using various statistical method. The numerical interpretation is also equivalent to measurements produced with a scientific instrument employing optometry principle, as evidenced by comparisons with other instruments. The assessment scale is an amalgamation of sensory visual evaluation with bio-physics that defines the optometric of the skin. The scale has been used to objectively assess skin glow and was found to be a highly sensitive assessment tool to assess all kind of dermatological products designed to provide enhanced glow and radiance.

**Keywords:** Skin glow, Glow, Glow and radiance, Skin radiance, Glowing skin

### INTRODUCTION

There are various claims related to skin pigmentation but the most subjective, yet the most appealing claim related to skin is, "improved glow and radiance". In clinical research, it is important to have a scientific approach and even though glow and radiance is a subjective term, we have developed a scientific multiparametric composite scale to assess skin glow and radiance using a numerical index- "glow and radiance index". There are several instruments available to evaluate skin pigmentation in terms of colour and melanin but there is no standardized or validated instrument to evaluate the glow and radiance of an individual. This assessment scale uses multiple parameters that can be evaluated with a standard

instrument individually. Hence the parametric comparisons with independent instrumental measurements have been included in this write-up to show the correlation between the scale and instruments.

Over the years, with multiple studies conducted, there is evidence that various skin attributes show a relationship with the glow and radiance. One of the most common correlations is with the term brightness. The background knowledge of how the light behaves and is perceived in terms of skin brightness, was the key factor in the development of the glow and radiance index (G&R index). Skin brightness is an outcome of multi-factorial interactions of light and skin. Using the background of bio-physics, the scale was developed involving 5 critical

parameters and was named MSCR-G&R-composite scale. A model for sensory visual evaluation of skin glow and radiance was developed in conjunction with expert dermatologists and clinical research scientists with data of over a hundred subjects, to define the skin parameters that impact glow and radiance.

**METHODS**

As per the definition, “glow and radiance” is a behavior of light on skin and depends on the fraction of the incident light that penetrates the skin and is reflected as the subcellular level. A part of the incident light is lost in the surface reflection and a part penetrates the upper layer of the skin and emerges after refraction and is termed subsurface reflection. A part of the incident light is completely absorbed by the skin, particularly by melanocytes. Subsurface reflection is a part of the total reflection and can be evaluated through polarized imaging which cuts the surface reflection (shine).

In order to align the visual assessment of glow and radiance, expert dermatologists concurred on the identification of skin parameters which share similar optical principles of physics: the hydration level of the skin has the most promising effect on the skin glow as it provides a clean healthy surface for scattering and clean optical path; good blood circulation gives an appealing pink hue; smooth skin surface, lets the light pass through the skin easily and attributes to glow; and pigmentation errors such as blotchiness, age spots etc absorbs the light in the localized area and reduces light reflectance.

“Higher the subsurface reflection, higher will be the skin glow”.<sup>1</sup>

A fraction of light is reflected and also scattered through the surface. This results in a loss of a certain proportion of the incident light. If the scattering is higher, the total incident light does not penetrate the stratum corneum, resulting in and loss of light from the surface and the total sub-surface reflective light to remain a smaller proportion.

The parameters that impact the surface reflection and scattering are physical screens such as sebum, dirt and the structural factors such as uneven surface in case of dry skin (roughness), wrinkles where the structural integrity of the stratum corneum is impacted. To an extent the structural changes are also seen in the epidermis layer which defines the skin texture. Clean skin and hydrated skin will have lesser light scattering and would allow higher amount visible light (incident light) to pass through.

Once the light passes the stratum corneum, there are two optical pathways: intercellular scattering, and absorption of light by melanocytes (melanin content).

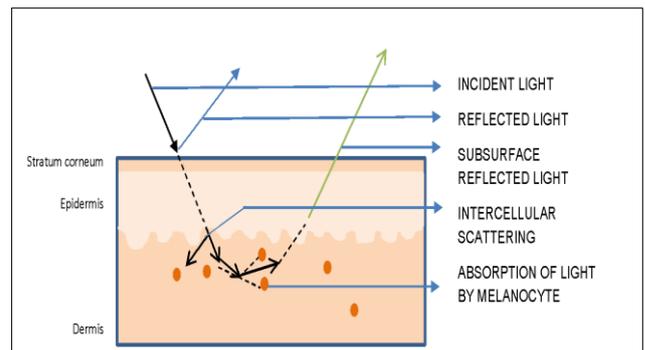
As we age, the distribution of melanocytes is not uniform<sup>2</sup> and there is an increase in the pigimentary spots along with a blotchy uneven skin appearance. This results in

dispersed light distribution across the face which impacts the amount of reflective light from the subsurface (Figure 1).

As seen in the Figure 1, the skin optics and their influential parameters can be related to the incident light and subsurface reflectance as seen in the Table 1.

**Table 1: Assessment parameters and their relationship with skin optics.**

Optics	Influencers	Assessment parameter
Incident light scattering	Physical screens-sebum	Background colour
	Structural integrity	Hydration
	Surface integrity	Texture (roughness, fine-lines, pores)
Subsurface reflectance	Intercellular scattering	Texture
	Absorption through melanocytes	Clarity, Evenness



**Figure 1: A representative diagram of the interaction of light on the skin surface, light scattering and refraction through subsurface of skin.**

Thus, the five visual skin attributes which mainly impact the G&R assessment were identified to be hydration, texture, skin colour, clarity and evenness. This also implies that glow assessment requires a larger area to comprehend the assessment.

It is also interesting to note that glow and radiance shows an inverse relationship with signs of aging where all of the above five parameters show a linear regressive relationship. As we age, the glow and radiance or skin resilience reduces which has been documented in the literature.<sup>2</sup>

**Scale and calculations**

The “multiparametric composite G&R scale” is based on the visual perception of skin hydration (h), texture (t), clarity (sc), evenness of skin tone (se) and background skin colour (bc). Each parameter is independently assessed

between (1-5) with a provision of intermediate scoring system. The scale is inclusive of all skin colors and ethnicities. The sensitivity of the scale has been validated with various skin products on skin of colour for visual representation of the scale on skin of colour population)

(Figure 2). Certain parameters of the composite scale were validated by comparing with the available benchmark instruments such as Spectrophotometer™ 2600D- Skin colour, evenness of skin colour and Corneometer™ CM 825- skin hydration.



**Figure 2: Visual representation of GR index in skin of colour population.**

Hydration levels are very easy differentiated. The skin shows significant results with any kind of topical treatment including water having a transient effect on the level of skin hydration. In order to make the scale sensitive, this parameter has been given least importance to negate the placebo or vehicle effect.

The skin type also has an impact on the assessment. Dry skin has more scope of improvement where as normal to hydrated skin has less scope of improvement. Thus, the self-limiting factor plays a crucial role and has been negated with a factor of 10% in the overall score. Skin texture shows a transient effect in presence of a topical application but it may or may not be a stable change.

However, since this parameter is present in both incident as well as reflective light this receives max individual allowance.

Skin clarity and evenness are a result of phenotypic changes. A change mostly marginal and are difficult to perceive. A visual difference of even 0.5 units is considered to be clinically significant. Considering these challenges, maximum magnitude in this index, is given to these two parameters.

Skin colour is a self-restricting factor and is not expected to change categorically. However, an improved background colour is recorded with a shift of up to 1 unit (on the given 5-point scale) for the mid – tone value. The fair skin population cannot show an improvement with product but would inherently be on a higher side. The index provided to this parameter is therefore minimum to avoid the impact of inherent skin color.

The assessment is computed and indexed where each parameter has a fixed, proportional calculation index. The formula considers the assessed parameters in a defined

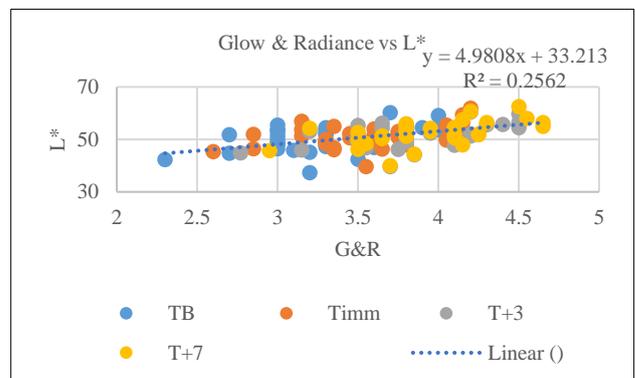
ratio based on its impact on the physical reflection of light from the surface and subsurface skin.

**RESULTS**

In order to establish and validate the sensitivity of the MSCR G&R index, the inherent glow (baseline profile) and the treatment effects under various test conditions were compared with standardized benchmark instruments.

**Study 1**

In a dermatologically controlled study with 35 female subjects between the ages of 20-45 years, a treatment effect of a face serum was evaluated over a period of one week. The correlation with the standard instruments were positive and in line with the indexing integers used to derive the G&R index. The serum contained skin lightening agent and was noted to show good improvement in GR index. It showed ~25% correlation with the Skin luminance and ~28% correlation with skin colour as seen in Figures 3 and 4. The skin hydration level is indexed in the G&R scale at 10% and in the study a correlation with Corneometer™ was noted to be about 8% (Figure 5).



**Figure 3: G&R index versus L\* (skin luminance).**

Table 2 must be referred for the comparison of various assessments in terms of statistical significance.

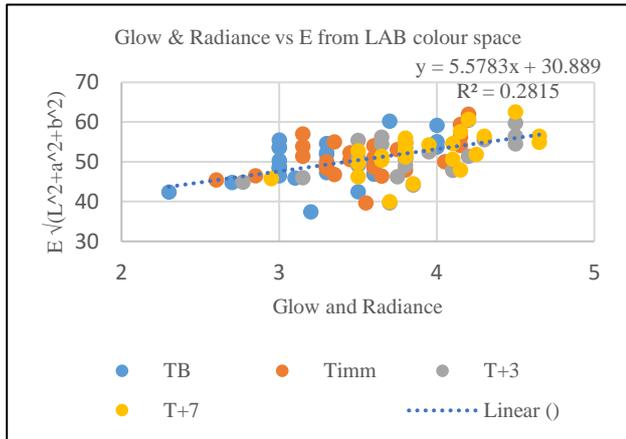


Figure 4: G&R index versus E (skin colour).

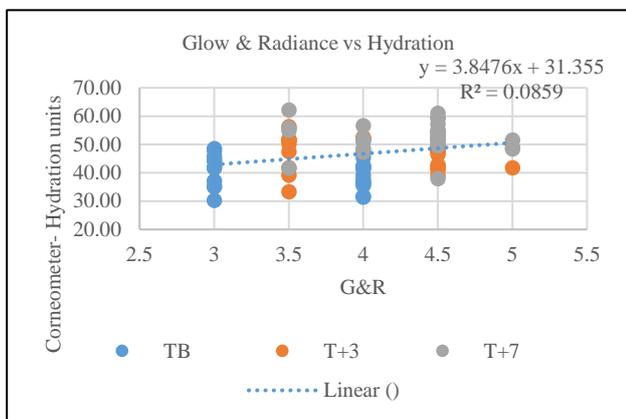


Figure 5: G&R index versus corneometer value.

The G&R index shows linear and positive correlation with Spectrophotometer L\* value as well as other assessments such as hydration texture and evenness (Figures 6 and 7).

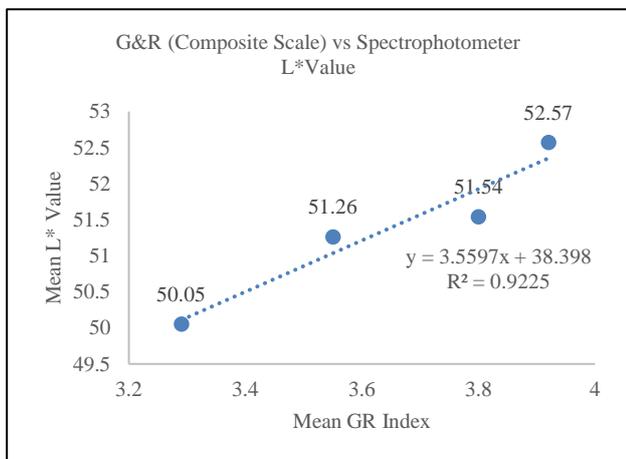


Figure 6: Linear and positive correlation between mean-GR composite scale versus mean L\*.

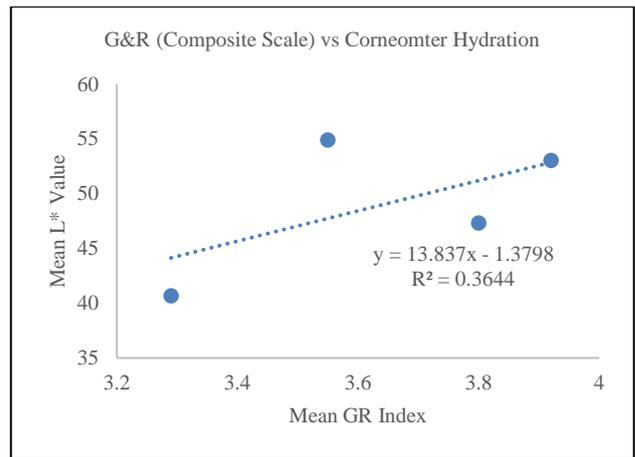


Figure 7: Linear and positive correlation between mean-GR composite scale versus mean hydration respectively.

It has to be noted that T-imm is 30 minutes post application and hence corneometer data shows an anticipated increased hydration value which has been negated as the transient effect in the G&R index.

### Study 2

In a dermatologically controlled study with 55 female subjects between the ages of 18-55 years, a treatment effect of a cleansing product was evaluated over a period of one month. The correlation with the standard instruments were positive and in line with the indexing integers used to derive the G&R index. The product itself did not contain a lightening agent, therefore the skin brightness showed lower correlation as compared to study 1 (Figures 8 and 9). The other parameters contributed in G&R and the effect was sensitively captured across all assessment parameters (Table 3). This further indicates that the G&R index is sensitive to pick all aspects and not dependent on colour correction only.

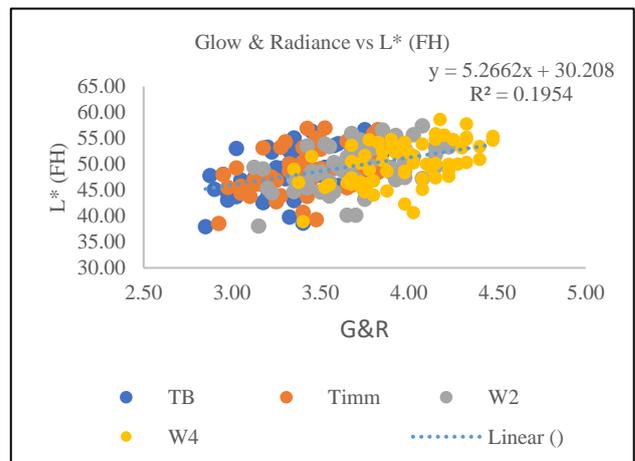
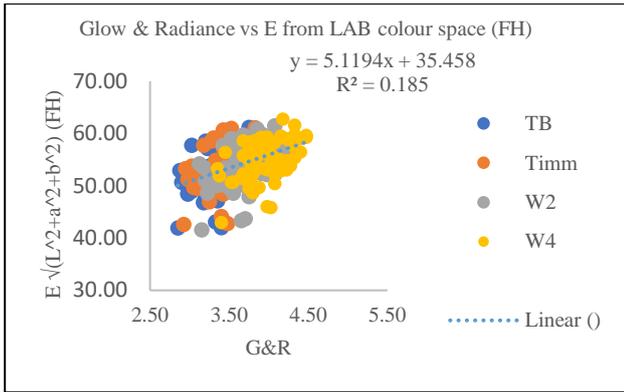
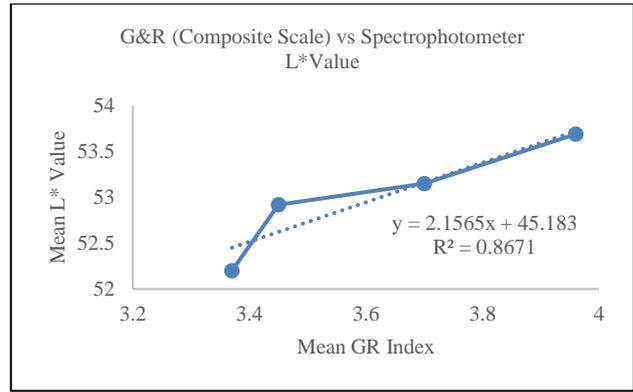


Figure 8: G&R index versus L\* (skin luminance).



**Figure 9: G&R index versus E (skin colour).**

As seen in Figure 10, the G&R index shows linear and positive correlation with Spectrophotometer L\* value. The statistical significance was seen in various skin parameters such as hydration texture and evenness in the study at the same time (Table 3).



**Figure 10: Linear correlation between mean-GR composite scale versus mean L\* (skin luminance).**

It has to be noted that T-imm is 30 minutes post application, where a clean face shows an anticipated increased skin brightness value which has been negated as the transient effect in the G&R index with respect to clarity, evenness and skin texture (Table 3).

**Table 2: Treatment effect (study 1) over baseline in terms of statistical significance by mean value comparison vs baseline for various assessment techniques.**

Parameters	Timepoints			
	TB	Timm	T+3	T+7
G&R (composite scale)	3.29	3.55***	3.80***	3.92***
Skin hydration (dermatological assessment)	3.57	4.04***	4.10***	4.27***
Skin texture (dermatological assessment)	3.54	4.01***	4.11***	4.27***
Spectrophotometer(L*)	50.05	51.26***	51.54***	52.57***
Skin hydration (corneometer)	40.68	54.90***	47.32***	53.05***
Evenness (spectrophotometer)	54.87	55.93***	56.21***	57.10***

**Table 3: Treatment effect (study 2) over baseline in terms of statistical significance by mean value comparison vs baseline for various assessment techniques.**

Parameters	Timepoints			
	TB	Timm	W2	W4
G&R (composite scale) - face	3.37	3.45***	3.70***	3.96***
Skin hydration (dermatological assessment)	3.14	3.39***	3.83***	4.19***
Skin texture (dermatological assessment)	3.1	3.39***	3.82***	4.19***
Skin tone evenness (dermatological assessment)	3.57	3.57	3.83***	4.06***
Spectrophotometer(L*) - forehead	48.43	49.18***	49.34***	50.17***
Spectrophotometer(L*) - cheeks	52.2	52.92***	53.15***	53.69***
Spectrophotometer(E) - forehead	53.12	53.96***	53.97***	54.95***
Spectrophotometer(E) - cheeks	56.75	57.48***	57.43***	58.11***

**Study 3**

In a recent study of 37 female subjects, the assessment was performed by a trained dermatologist using both MSCR G&R composite scale and a subjective 10-point linear scale (0-9). Given the sample size and product category (cleansing product), the statistical significance was attained with the MSCR-G&R-composite scale but could not be attained by the linear scale (Table 4). This further

demonstrated and confirmed the sensitivity of the MSCR-G&R-composite assessment scale.

As per the measurement with instrumental evaluations, the significance of the associated parameters namely hydration, texture and skin luminance were attained at the same time points. This corroborates the correlation between MSCR-G&R-composite scale and standardized instrumental evaluation. In another study with a colour

cosmetic product on 35 female subjects, it was noted that the scale was able to differentiate between glow and shine. Aesthetically, a visible shine on human skin is an unappealing attribute as it relates to skin oiliness and greasiness.

**Table 4: Statistical analysis using two different scales for glow and radiance.**

Parameters	Timepoints		
	TB	Timm	W2
G&R (composite scale)	2.35	2.39***	2.75***
G&R (parametric scale)	6.19	6.19	6.72***

## DISCUSSION

Radiance, as an optical parameter defined by physics, can be measured in terms of the amount of light that is emitted from a particular object, such as a light source. If we apply this definition to skin radiance, then when the skin reflects more incident light should look more radiant. However, skin radiance is more complex, is a psychophysical parameter, is the mirror of general health, both physical and psychological, and involves more than simply the quantity of light that is reflected from the skin.<sup>1,15</sup>

A dull skin may reflect with a blotchy, possibly darker complexion because of fatigue, weariness, hormonal status, emotional states (sadness and stress), illness (dysfunction of vital organs such as the liver), nutrition deficiency or excess, tobacco, alcohol, pollution, and seasons.<sup>3-7</sup> Inversely “glowing and radiant skin” reflects a smooth, brighter, pink, and velvety skin with good health status.

Many articles showed that the perception of aging is highly influenced by the skin tone uniformity which also contributes to the perception of glowing and radiant skin.<sup>8-12</sup>

According to current literature, no precise definition and quantifiable description exists for skin radiance. It is difficult to list all constituting parameters and their relative proportions as they involve quite complicated surface and internal qualities of the skin.<sup>13</sup>

When the light meets the skin surface, a small quantity (about 5%) is reflected directly, while the major part penetrates to the different layers of the skin.<sup>14</sup> The specular light gives its luminous aspect, whereas the back-scattered light gives the complexion (Figure 1). In other words, specular reflection explains the glow (depending on the nature and state of the surface of the skin), absorption phenomena explain its hue (depending on the skin's chromophore content), whereas diffusion phenomena define its saturation (depending mostly on the collagen content).

In simpler terms glow is “inner skin luminance”. Skin luminosity was defined as the intensity of the light areas reflected on the salient areas of the face, while skin brightness was the combined uniformity of skin coloring and skin texture, and skin transparency was the possibility of seeing the vessels beneath the skin. G&R are dependent on how the incident light behaves with the skin and how much light is reflected from the face, at sub surface level. The glow is not entirely dependent on the skin colour of the person, i.e., a darker skin tone person can have very good skin glow. However uneven distribution of skin colour i.e., uneven skin tone, blemishes and spots results in varied reflectance of light from the skin surface and results in dullness of the skin.<sup>13</sup>

The optical appearance of the skin such as radiance, glow, and shine can be quantified by determining the light-reflection profile of the skin. Understanding the optical-reflection characteristics by means of objective measurements is the first step in investigating these aspects of facial appearance. The reflection of light from the skin is complicated by its multilayer structure. The stratum corneum, the outermost layer of the epidermis, is optically translucent and reflects partially incident light while allowing most of it to penetrate to deeper layers of the skin. As a result, the reflection from the skin is a mixture of specular surface reflection and diffuses subsurface reflection. It is therefore necessary to separate the surface and subsurface reflections from the skin to achieve a concept of the fundamental optical characteristics associated with its appearance.<sup>1</sup>

The assessment of the light reflexion provides direct information on the skin radiance. It is generally admitted that radiant skin tends to act as a mirror, that is, to reflect rays in a specular manner, and dull skin tends to diffuse light more.<sup>15</sup>

Clinical scoring offers the possibility to evaluate the different parameters implicated in the skin radiance. With contrast to the colour, the glow remains difficult to quantify. The development of simulation systems would perhaps be one solution.<sup>16</sup> Many terms are usually employed to characterize the skin radiance: shininess, brightness, glow, glare, and gloss. Shininess, brightness, and gloss refer to the reflection of light to something and are more frequently used to characterize seborrhic skin or to assess the effect of makeup on lips. Glare seems to evoke a shine with a dazzling light, whereas the glow associates an intense color with a slight shine. The glowing aspect of the skin has thus to be differentiated from its brightness, which is the characteristic of greasy skin and is inaeesthetic. If gloss is what women expect for their hair, glow is a better representation of radiant skin. All these notions showed a real need to define the skin radiance more accurately.<sup>13</sup>

In our attempt to accurately define skin glow as a positive attribute and shine and a negative attribute, the scale has been able to sensitively differentiate the test products even

when the standard instruments such as Spectrophotometer™ and Corneometer™ have shown some limitations. The scale requires appropriate training and practice and regular calibration for evaluators/assessors. In any study, it is advisable to maintain a single assessor to avoid assessor-based variabilities.

G&R is a very subjective consumer perception. In a skin of colour population, e.g., the Indian population, skin dullness is associated with darker looking skin (Figure 2). The optics of the skin colour is associated with skin brightness and skin tone. The scale was developed to provide an objective, scientific assessment tool for a subjective perception, which is a result of skin optics defined by various skin attributes.

In all of the studies presented here, it can be noted that the scale is sensitive in assessing the subtle change in the skin appearance. The scale generates numerical values that can further be analysed through various standardized statistical methods. The validation of the scale with various assessments (Tables 2 and 3) confirms that the numerical interpretation of G&R is sensitive and accurate.

## CONCLUSION

Over the past four years, the assessment scale and the index has been used to assess over 30 topical products of various categories, from topical creams and lotion to soaps and serums, in more than 1000 subjects. The scale has also been used and validated against the imaging assessment using VISIA CR cross and polarized images. The scale has shown strong correlation with dermatological, objective (instrumental) and subjective assessments, where statistical significance was achieved across all assessment parameters at similar evaluation time-points.

The scale has demonstrated reproducibility and scientific benefit for assessing a subjective skin attribute resulting in a quantifiable value. It is a sensitive and practical solution to provide a numerical interpretation of a subjective perception. This scale has clearly demonstrated efficacy for a varied skin of colour population. Further, studies are ongoing to validate across larger and extensive populations, extra-facial skin sites and across various topical products.

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## REFERENCES

1. Matsubara A. Differences in the surface and subsurface reflection characteristics of facial skin by age group. *Skin Res Technol.* 2012;18(1):29-35.
2. Pigmentary Changes Associated with Skin Aging, The Dermatologist Board Review. 2019. Available at: <https://www.hmpgloballearningnetwork.com/site/thederm/site/cathlab/event/pigmentary-changes-associated-skin-aging>. Accessed on 12 July 2022.
3. Purdue GF, Hunt JL. Cold Injury: a collective review. *J Burn Care Rehabil.* 1986;7(4):331-42.
4. Middleton JD. The mechanism of water binding in stratum corneum. *Br J Dermatol.* 1968;80:437-50.
5. Monfrecola G, Riccio G, Savarese C, Posteraro G, Procaccini EM. The acute effect of smoking on cutaneous microcirculation blood flow in habitual smokers and nonsmokers. *Dermatology.* 1998;197(2):115-8.
6. Koh JS, Kang H, Choi SW, Kim HO. Cigarette smoking associated with premature facial wrinkling: image analysis of facial skin replicas. *Int J Dermatol.* 2002;41(1):21-7.
7. Besné I, Clot JP, Misery L, Breton L. Stress et dermatologie, Chapter 18. In: Thurin JM, Baumann N, editors. *Stress, pathologies et immunité.* Paris: Médecine-Sciences Flammarion; 2003;192-9.
8. Nkengne A, Bertin C, Stamatas GN, Giron A, Rossi A, Issachar N. Influence of facial skin attributes on the perceived age of Caucasian women. *J Eur Acad Dermatol Venereol.* 2008;8:982-91.
9. Puccetti G, Nguyen T, Stroeve C. Skin colorimetric parameters involved in skin age perception. *Skin Res Technol.* 2011;17:129-34.
10. Fink B, Matts PJ. The effects of skin colour distribution and topography cues on the perception of female facial age and health. *J Eur Acad Dermatol Venereol.* 2008;22:493-8.
11. Matts PJ, Fink B, Grammer K, Burquest M. Color homogeneity and visual perception of age, health, and attractiveness of female facial skin. *J Am Acad Dermatol.* 2007;57:977-84.
12. Fink B, Matts PJ, D'Emiliano D, Bunse L, Weege B, Röder S. Colour homogeneity and visual perception of age, health and attractiveness of male facial skin. *J Eur Acad Dermatol Venereol.* 2012;26:1486-92.
13. Jeudy A, Mac-Mary S, Sainthillier JM, Lihoreau T, Fanian F, Humbert P. Skin radiance measurement. In: Barel AO, Paye M, Maibach HI, editors. *Handbook of cosmetic science and technology.* 4th ed. New York: Edition Informa Healthcare. 2014;459-66.
14. Takiwaki H, Kanno Y, Miyaoka Y, Arase S. Computer simulation of skin color based on a multilayered skin model. *Skin Res Technol.* 1997;3:36-41.
15. Petitjean A, Sainthillier JM, Mac-Mary S, Muret P, Closs B, Gharbi T, Humbert P. Validation of technique measuring skin radiance. *Skin Res Technol.* 2007;13:2-8.

16. Minami K, Kaneko T, Suzamwa T, Aosaki T, Nagatami N, Hotta H, Hori K. Changes in facial impressions by controlling the color of surface reflection from cosmetic foundations: appearance evaluation and formulation technique. *IFSCC. 2007;10:111-7.*

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