

Review

An Overview of Methods to Characterize Skin Type: Focus on Visual Rating Scales and Self-Report Instruments

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Abstract: Skin type classification is important because it provides guidance for professionals and consumers to recommend and select the most appropriate cosmetic products and skin care protocols and it is also important in clinical research. Several methods have been proposed for classifying skin typologies such as non-invasive bioengineering tools (examples: Corneometer[®] and Sebumeter[®]), visual and tactile methods (subjective methods that evaluate skin appearance, texture, temperature, and abnormalities), artificial intelligence-based tools and instruments (examples: visual rating scales, and self-report instruments). Examples of known visual rating scales used to classify skin aging are the Griffiths Photonumeric Scale, the Glogau Scale, and the SCINEXA Scale. The Fitzpatrick Skin Phototype Classification and the Baumann Skin Type System are some of the self-report instruments used for skin type classification. Despite the diversity of methods to classify skin type and degree of skin aging, data on instruments are scarce and not adequately compiled. Validation in larger samples and with individuals of different ethnicities and geographic locations is needed to promote a more universal use. Visual rating scales and instruments are interesting tools that allow the skin to be promptly and efficiently examined, without using costly or complex equipment, and are very useful in a clinical or self-assessment context.

Keywords: skin hydration; sebum production; skin sensitivity; wrinkle; photoaging; skin type; instruments; visual rating scales



Citation: Oliveira, R.; Ferreira, J.; Azevedo, L.F.; Almeida, I.F. An Overview of Methods to Characterize Skin Type: Focus on Visual Rating Scales and Self-Report Instruments. *Cosmetics* **2023**, *10*, 14. <https://doi.org/10.3390/cosmetics10010014>

Academic Editor: Enzo Berardesca

Received: 13 December 2022

Revised: 6 January 2023

Accepted: 8 January 2023

Published: 11 January 2023



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1. Introduction

The skin and its appendages make up the first line of defense against factors and threats coming from the outside. Consequently, its functions are an effective barrier and an endocrine and immune system, maintaining homeostasis, excretion, body limit, and metabolism [1].

Normal healthy skin exhibits flexibility, elasticity, and resilience, characteristics to which the cohesion of the stratum corneum and its degree of keratinization (organized in the brick-and-mortar model), the consistency of the collagen and elastic fibers, and the degree of hydration contribute. The water binding capacity is related to the degree of impermeability of the skin (presence of hydrophobic lipids and functional groups with water affinity) to prevent evaporation and to ensure deeper hydration, the glycosaminoglycans present in the dermis, such as hyaluronic acid, are fundamental [2].

The sebaceous and sweat secretions, and the constant shedding of the stratum corneum ensure the physiological pH and the skin microbiota, essential for a normal appearance and to prevent dermatological pathologies [3]. The sebum is responsible for skin lubrication, and prevention of dehydration, and has a fungistatic and bactericidal action. The sweat glands produce apocrine and eccrine sweat, maintain the skin hydrated and keep the skin acidity (pH 4–6.8) [2].

Cutaneous aging may be classified as intrinsic or extrinsic. The first one happens due to the senescence that is genetically controlled and the second one is due to external factors, collectively known as exposome which includes lifestyle (smoking), excessive sun exposure, and pollution. Photoaging is a condition that involves the appearance of wrinkles, sunspots and uneven skin color, dryness, and loss of elasticity [4]. There are two photoaging phenotypes: hypertrophic photoaging with thick and deep wrinkles, and atrophic photoaging, with a smooth and relatively unwrinkled appearance, telangiectasia, and the appearance of lesions on the skin [5,6].

The aged skin, in general, is thinner and more fragile when compared with younger skin. Whereas the intrinsically aged skin is thin, with no elasticity, and wrinkly, with the deepening of expression lines. Extrinsically aged skin presents itself as blotchy, thick, yellowish, lax, and rough. The superficial layer of the epidermis gets thicker with aging because the shedding process does not occur properly, leading to the accumulation of corneocytes on the skin's surface [4]. Fibroblasts present high importance on the skin since they are responsible for collagen (types I, III, and VII are the most important for the skin), elastin, and hyaluronic acid production. Fibroblast activity is important for the skin's thickness, volume, elasticity, and strength. So, aged skin presents less type I and III collagen, less functioning elastin, and less hyaluronic acid [5].

Knowledge of skin type is of utmost importance when choosing appropriate self-treatment cosmetic products or clinical evaluation for robust data-based decision making. Furthermore, studies show that individuals incorrectly self-assess their skin type [7]. The use of inappropriate products can lead to skin disorders and disappoint consumer expectations. The knowledge of the skin type is also important before performing any medical or cosmetic procedures since it can be used to select the most appropriate procedure and to predict and avoid skin reactions and post-procedure complications. A careful and correct classification of the skin type is also relevant because there are several skin types, and they are not static, so it is important to re-evaluate the skin type over the years.

Multiple ethnicity and globalization give rise to varied human skin phenotypes with their particular and complex needs. The response to these needs must be as targeted as possible and the cosmetics market is also following this evolution. Not knowing the type of skin and its characteristics can lead to wrong results with several consequences ranging from changes in the skin physiology to serious adverse effects in aesthetic procedures.

Different criteria are commonly used to classify skin type and skin aging according to the stratum corneum moisture content, type of hydrolipidic film, sun reaction, pigmentation and skin color, sensitivity, and presence of skin aging signs such as wrinkles, depigmentation, uneven texture, and lack of elasticity.

There is a wide variety of methods to classify skin types that evaluate different skin parameters such as non-invasive instrumental methods (bioengineering tools), visual and tactile methods, and other methods such as instruments (visual rating scales and self-report instruments).

Non-invasive instrumental methods and imaging methods for skin classification are extensively described in literature while scales and self-reported instruments remain unclear and poorly standardized as subjective methods. The research in this field evolves rapidly and new instruments are expected to be under development. It is thus paramount to collect and organize data on skin classification instruments to support research in this field.

2. Skin Type Classification

The skin typology can be classified according to different criteria such as the stratum corneum hydration, the type of hydrolipidic film, sun reaction, pigmentation and skin color, sensitivity, and skin aging signs:

- Stratum corneum hydration: a stratum corneum with a water content of around 10% has optimal hydration and consequently the skin is resistant, supple, luminous, soft, and smooth. When the water content is lower, the skin has a rough appearance, lacks flexibility, and may present flaking and dehydration lines [8].
- Hydrolipidic film: is made up of a mixture of sweat and sebum. It varies from individual to individual depending on its qualitative and quantitative composition, so the proportion of the aqueous and lipid phases will influence the skin type [8]. Sebum production varies with age, gender, and topographical variations of the skin. Oily skin has a more lipophilic hydrolipidic film because of greater sebum secretion. Skin tightness after washing, pore size and number, daily oiliness, and makeup maintenance are all factors to characterize skin as oily or dry [7].
- Sun reaction: depends on the sensitivity to the sun, tanning ability, and the frequency of appearance of solar erythema, and these characteristics will help determine the phototype [8].
- Skin color: is the combination of melanin (yellowish-brown color) and hemoglobin (red color). Skin color is determined genetically and has to do with the melanin distribution on the epidermis. However, skin color may also be the result of environmental factors such as sun exposure and hormonal factors that lead to an increase in the amount of melanin on the epidermis [9].
- Sensitivity: reflects the appearance of unpleasant sensations such as stinging, burning, pain, pruritus, and tingling, accompanied or not by erythema, due to a stimulus, which in normal skin would not cause these sensations [10].
- Skin aging signs: wrinkles, uneven pigmentation and texture, and lack of elasticity [11].

The classification methods of the skin type involve non-invasive bioengineering tools, visual and tactile methods, and other methods encompassing scales, color charts, and questionnaires/surveys (frequently referred to as self-report instruments).

Non-invasive bioengineering tools are based on biophysical principles and skin-imaging techniques. They allow objective measurements of skin parameters and aim to quantitatively reproduce biological phenomena. Several non-invasive equipment have been developed over the years to assess skin biologic indicators such as stratum corneum water content (Corneometer[®] (Courage + Khazaka electronic GmbH, Cologne, Germany) for capacitance, Skicon 200[®] (IBS Ltd., Hamamatsu, Shizukoka, Japan) for conductance, The Nova[®] Dermal Phase Meter (NOVA Technology Corporation, Broussard, LA, USA) for impedance; transepidermal water loss (TEWL) (Tewameter[®] (Courage + Khazaka electronic GmbH, Cologne, Germany)); lipidic content (Sebumeter[®] (Courage + Khazaka electronic GmbH, Cologne, Germany) and Sebutape[®] (Cuderm Corporation, Dallas, TX, USA)); skin color (DermaSpectometer[®] (Cortex Technology, Hadsund, Denmark), Mexameter[®] (Courage + Khazaka electronic GmbH, Cologne, Germany), Chromameter[®] (Minolta, Tokyo, Japan), Erythema Meter[®] (Diastron, Andover, Hampshire, United Kingdom)); skin mechanical properties (Indentometer[®] (Courage + Khazaka electronic GmbH, Cologne, Germany), Cutometer[®] (Courage + Khazaka electronic GmbH, Cologne, Germany), CutiScan[®] (Courage + Khazaka electronic GmbH, Cologne, Germany), DermaLab[®] (Cortex Technology, Hadsund, Denmark), Torsional Ballistomer[®] (Diastron, Andover, Hampshire, United Kingdom), Dia-Stron[®] (Diastron, Andover, Hampshire, United Kingdom), Elastimeter[®] (Delfin Technology, Kuopio, Finland), Durometer[®] (Rex Gauge, Buffalo Grove, IL, USA), DynaSKIN[®] (Eotech SA, Marcoussis, France)) [12–16].

Imaging techniques are also applied to evaluate skin allowing the detailed assessment of superficial or in-depth skin morphology. These techniques provide information for diagnosis and skin evaluation, and comprise clinical photography, dermatoscopy, surface microscopy, confocal microscopy, ultrasounds, or magnetic resonance imaging [16–19].

Visual methods involve observing the individual's skin and evaluating its appearance, texture, and possible abnormalities (wrinkles, comedones, acne, flaking, redness, rosacea, pigmentation spots). Tactile methods can be used to evaluate the texture, thickness, temperature, elasticity, and firmness of the skin and the presence of stretch marks. These methods are subjective and dependent on the evaluator's experience [8]. Together, these methods categorize the skin into its traditional types:

- Normal skin: Visually, looks uniform, luminous, without excessive shine, and has a smooth and even texture without apparent pores. In a tactile examination, the skin appears fresh and smooth, with normal thickness, hydrated, firm, and flexible.
- Dry skin: On visual examination, looks clear, dull (sebum deficiency), and sometimes flaky. It has no visible pores and may have eczematous, reddish areas and rosacea. On tactile examination, the skin appears cold, thin, rough, with little flexibility, and often with dehydration streaks.
- Oily skin: has a shiny appearance, uneven texture with very large pores. It may have comedones and pimples, acne scars, and skin irritations. On tactile examination, the skin is oily, smooth, hyper-seborrheic, and thick.
- Sensitive skin: Visually, shows seborrheic dermatitis, signs of rosacea, scaling, blisters, edemas, redness, and dryness. It can appear hot and rough.
- Aging skin: Exhibits a pale and dull appearance, uneven texture, presence of wrinkles, enlarged pores, and comedones and dyschromic spots. Upon tactile examination, the skin appears cold, thin, dry, rough, and inelastic.

Questionnaires/surveys, visual rating scales, and self-report instruments are used in dermatological/cosmetic research and practice to classify skin types. To provide meaningful information, these methods need to be valid and reliable [20]. Some of the most commonly employed instruments for skin characterization will be explored below.

3. Instruments

3.1. Self-Report Instruments

3.1.1. The Baumann Skin Type System (BSTS)

The Baumann Skin Type System is a skin type classification that involves the combination of four skin parameters: hydration, sensitivity, pigmentation, and elasticity. This system creates 16 possible skin phenotypes (Table 1) [21]. It applies to all ethnicities, ages, and genders, and is defined by a validated questionnaire (64-item questionnaire) called The Baumann Skin Type Indicator (BSTI) [22–24]. The Baumann Skin Type is calculated by a software that assigns a letter to which parameter and if applicable, a subtype of sensitive skin. However, skin types are not always static, they can suffer alterations due to different climates, stress, pregnancy, and menopause.

Table 1. The Baumann skin type system (BSTS) [21].

	Oily		Dry		
	Pigmented	Nonpigmented	Pigmented	Nonpigmented	
Wrinkled	OSPW	OSNW	DSPW	DSNW	Sensitive
Tight	OSPT	OSNT	DSPT	DSNT	Sensitive
Wrinkled	ORPW	ORNW	DRPW	DRNW	Resistant
Tight	ORPT	ORNT	DRPT	DRNT	Resistant

D, dry; N, nonpigmented; O, oily; P, pigmented; R, resistant; S, sensitive; T, tight; W, wrinkled.

The BSTI questionnaire is composed of questions about skin characteristics that will allow the skin to be categorized [25]:

- Hydration (dry (D) vs. oily (O)): Dry skin (D) is characterized by the lack of water content (lower than 10%) on the stratum corneum and an increase of the TEWL. The dry skin's symptoms such as rough skin, fissures, and cracks will be questioned on the BSTI. Oily skin (O) is connected to high sebum production. Combination skin

may be classified as O (oily skin) or D (dry skin) depending on the characteristics found by the BSTI questionnaire. There are two types of combination skin—Seasonal Skin—dry during winter and in dry climates, and oily during summer and in humid climates—and T-zone skin—oily on the T-zone (forehead, nose, and chin) and dry on both sides of the face. Normal skin can be classified as O1 or D1. When it has an intact barrier with a normal TEWL and a normal production of sebum, it is classified as an O1. When the skin presents an intact barrier, but the sebum production is below normal, it is classified as a D1.

- Skin sensitivity (resistant (R) vs. sensitive (S)): Resistant skin has a strong stratum corneum and in this classification system, it is defined as skin that presents no signs of inflammation. Individuals with this skin type can use any kind of skin care product without developing irritation, acne, or stinging sensation. Resistant skin does not have a score, being that the individual either possesses resistant skin or not. Sensitive skin includes 5 different subtypes: acne subtype (S1), rosacea subtype (S2), stinging subtype (S3), allergic subtype (S4), and seborrheic dermatitis (S5). Inflammation is common among all these sensitive skin subtypes.
- Skin pigmentation (pigmented (P) vs. nonpigmented (N)): This parameter measures the tendency to develop dark spots on the skin (melasma or solar lentigos) as a result of sun exposure. Pigmentation is classified numerically from 1 to 4, according to the probability of developing pigmentation issues.
- Skin elasticity (wrinkled (W) vs. tight (T)): This parameter is influenced by age and ethnicity, as well as lifestyle. Photo-aged skin presents spots on the skin and freckles caused by sun exposure accompanied by wrinkles, being classified as a PW skin type (pigmented and wrinkled).

Once the skin type is characterized with a 4-letter acronym, the user or practitioner will be able to make more informed decisions regarding skin care recommendations.

This questionnaire has been validated regarding skin oiliness. Reliability (using Cronbach's alpha) and criterion validity (by correlation with Sebumeter® readings) were established in a sample of 100 individuals [24]. The questionnaire also proved to be valid among all ethnicities and in various geographic locations [22].

Ahn et al. performed a descriptive study to characterize the skin type of Korean women and found that the OSNT, DSNT, DRNT, and OSNW skin types were the most common. They also manage to compare the four BST parameters according to age, region, smoking and drinking habits, occupation, blood type, and UV exposure, an observed significant difference [26]. The same authors characterized the skin type of the male Korean population using the BSTS, and the OSNW type resulted in the predominant male skin type [27]. These studies found the most common skin type among the Korean population and its regional and age distribution, intrinsic and extrinsic factors related to skin type, contributing to the knowledge of the population's skin characteristics.

A pilot study using the BSTS, including fifty Korean female post-adolescent acne patients, showed that this population was significantly associated with sensitive skin type and wrinkled skin type rather than oily skin type [28]. These results contrast with several studies relating acne disease to sebum production [29]. Several factors such as lipid content profile, nutrition, and ethnicity may in part explain the discrepancies.

Kanezawa et al. related the BST classification with the constitution theory of Chinese Medicine, finding an association between skin conditions and body constitutions among 187 Japanese females [30].

3.1.2. The Fitzpatrick Skin Phototype Classification (FSPC)

The Fitzpatrick Skin Phototype is a classification (Table 2) based on the skin's response to sun exposure and takes into account the tendency that the individual presents to get sunburned and tanned. It is a questionnaire that is based on genetic predisposition, reaction to sun exposure, and tanning habits [9,31].

Table 2. The Fitzpatrick Skin Phototype Classification [9,31].

Type I	Pale white skin, always burns, never tans
Type II	White skin, burns easily, minimal tan
Type III	Medium white skin, sometimes burns, tans slowly
Type IV	Moderate brown skin, burns minimally, tans easily
Type V	Brown skin, rarely burns
Type VI	Dark brown skin, never burns

However, FSPC presents limitations due to its subjective character and the lack of consistent correlation with a minimum dose of erythema. The skin phototyping results may vary depending on the evaluator, the evaluation method (interview or self-report), and the variation of the question formulation which may lead to different answers [9]. This method is also often questioned for the assessment of actinic sensitivity, leading to controversial results, even in self-assessment [32–34]. It appears that the Fitzpatrick Skin Phototyping Classification is more adequate and validated for the white skin population than for non-white skin [35]. Gonzales et al. developed a diffuse reflectance spectrophotometric method to measure skin pigmentation related to the clinical assessment of the traditional Fitzpatrick Skin phototyping evaluation and concluded that both methods could be complementary [36]. The same method was applied to the Indian population to help to differentiate dark-skin levels [37].

Nevertheless, FSPC is widely used when it is important to characterize tanned skin degree, applied to studies such as photosensitivity [38,39], laser safety [40,41], or as a disease predictor, such as skin melanoma, Parkinson’s disease, or hearing loss [42–46].

Test–retest reliability of the self-rated FSPC was previously established in a sample of 244 students, in a 12-month cohort study that examined the psychological sequelae of acne. Results showed a good-to-very-good agreement through quadratic weighted kappa measures, indicating that FSPC is a reliable method for assessing skin phenotype [47].

3.1.3. The Roberts Skin Type Classification System

In Roberts Skin Type Classification System four skin characteristics are evaluated: phototype, photoaging, hyperpigmentation, and scarring ability (scar morphology) [48]. Thus, it involves four classification systems summarizing a final total score [9,31]:

- Fitzpatrick Phototype Scale: a 6-point scale based on skins’ reaction to sun exposure (type I to VI);
- Glogau Scale: A 4-point scale that classifies photoaging skin degree based on wrinkles’ skin examination (type I to IV);
- Roberts Hyperpigmentation Scale: A 7-point scale that determines the post-inflammatory pigmentation and the probability to acquire a pigmentation problem (type 0—hypopigmentation; type I—minimal and transient hyperpigmentation; type II—minimal and permanent hyperpigmentation; type III—moderate and transient hyperpigmentation; type IV—moderate and permanent hyperpigmentation; type V—severe and transient hyperpigmentation; type VI—severe and permanent hyperpigmentation);
- Roberts Scarring Scale: A 6-point scale that identifies the patterns of scarring, by evaluating how the individual’s skin reacts to injury and inflammations (type 0—atrophy; type I—no scar; type II—macule; type III—plaque; type IV—keloid; type V—keloidal nodule).

This classification system can be used on individuals of any skin color and is useful in clinical practice [48] since it can predict the skin’s response to injury and inflammation after aesthetic procedures or due to post-procedure complications, supporting the treatment strategy [9]. The Roberts Skin Type Classification System helps to select and plan medical and cosmetic procedures and the appropriate treatment products, allows for managing wound care and skin repair, and determines the short and long-term effects of these treatments and procedures [31].

3.2. Visual Rating Scales

3.2.1. The Glogau Scale

The Glogau Scale is used to classify the degree of photoaging and the presence of wrinkles. This scale consists in the evaluation of the photoaged skin and associated wrinkles according to skin characteristics [9,49]: Type I no wrinkles, early photoaging; type II wrinkles in motion, early to moderate photoaging; type III wrinkles at rest, advanced photoaging; type IV only wrinkles, severe photoaging.

One disadvantage of this scale is that it has a certain degree of subjectivity associated with the clinical researcher's assessment and it does not address the photoaging signs in mixed racial-ethnic skin types [31].

Recently, a study has managed to correlate the Glogau Photoaging Scale and the VISIA-CR Complexion Analysis System, in an attempt to reduce the variability of the photodamage assessment [50].

Otherwise, the Glogau scale is a classic method to evaluate skin photoaging in efficacy studies of antiaging treatments such as laser [51,52], surgery [52], radiofrequency [53], skin aging treatments (e.g., platelet-rich plasma treatments or retinoic acid treatments) [54,55], or cosmetics [56].

Buendía-Eisman et al. performed a cross-sectional study to assess the Spanish population exposome in 1474 male and female participants, and the Glogau scale was used to evaluate the degree of skin aging. They developed a logistic predictive model showing that skincare habits and sunscreen protection may prevent skin aging, while smoking impacts negatively, thereby contributing further scientific evidence to common knowledge [57].

3.2.2. The Griffiths Photonumeric Scale

The Griffiths Photonumeric Scale allows the classification of the photoaged skin through the severity of cutaneous photodamage. This scale is a 9-point visual scale that uses photographs showing increasing degrees of photodamage, where 0 corresponds to no severity of photoaging and 8 corresponds to high severity of photoaging [58–60]. Scales to evaluate hypertrophic and atrophic facial photoaging [5], where 0 = no photoaging, 2 = mild, 4 = moderate, 6 = severe, and 8 = very severe [60].

Brooke et al. assessed the grade of facial wrinkling using the validated Griffiths Photonumeric Scale and found a negative association between the grade of wrinkling and the risk of developing a basal cell carcinoma (BCC), proposing that the mechanisms of skin aging may be different from the factors that lead to the appearance of BCC [61]. Later, Richmond-Sinclair et al. assessed signs of cumulative photodamage (telangiectasia of the face, elastosis of the neck, solar lentigines, and solar keratoses) on a participant sample of the Nambour skin cancer study. The authors demonstrated by logistic regression that chronic skin photodamage predicts multiple occurrences of BCC, as well as BCC development on uncommonly sun-exposed body sites such as limbs or trunks [62].

Griffiths Photonumeric Scale, among three other validated photonumeric scales, was used to evaluate the efficacy of topical fluorouracil 5% cream on photoaging, on 932 US veterans with a recent history of two or more keratinocyte carcinomas, as a result of a secondary analysis of the Veterans Affairs Keratinocyte Carcinoma Chemoprevention Clinical Trial. The study did not demonstrate the efficacy of the fluorouracil 5% cream, but the question was raised of the need to include in the evaluation of photodamage other signs besides the wrinkle evaluation, such as the appearance of lentigines, hyperpigmentation, and telangiectasias [63].

Betz-Stablein et al. applied the Griffiths Photonumeric Scale to assess whole-body patterns of photodamage in 190 Australian adults and found an association between site-specific photodamage and the development of sun-associated skin carcinogenesis [64].

3.2.3. The Score of Intrinsic and Extrinsic Aging—SCINEXA

The Score of Intrinsic and Extrinsic Aging (SCINEXA) is a scale that evaluates independently intrinsic and extrinsic skin aging, allowing their distinction. This scale involves signs

of intrinsic aging such as uneven pigmentation, fine wrinkles, lax appearance, reduced fat tissue, and the presence of benign skin tumors. It also includes signs of extrinsic aging such as yellowness, coarse wrinkles, elastosis, telangiectasias, and the presence of malignant skin tumors. Each of these parameters will be scored to a maximum of 69 points (15 points for intrinsic photoaging and 54 points for extrinsic photoaging) by clinical examination [58,65].

The SCINEXA score was used in several studies to evaluate skin aging, such as the influence of air pollution [66,67], chronic poor sleep quality [68], and even genetic variants associated with skin aging [69,70].

Vierkötter et al. studied extrinsic skin aging using the SCINEXA score, testing for ethnic differences, age, and site dependence adjusted for educational level, sun exposure, smoking, and sun protection habits, in German, Japanese and Chinese women. This study showed a difference between the occurrence of pigment spots and wrinkles in Caucasians and East Asian women. It was also demonstrated that this difference depends on age, anatomical site, and different ethnic groups from East Asia [71].

SCINEXA score was used to assess the degree of skin aging and the prevalence of skin tumors in an elderly population enrolled in the PROOF (PROgnostic indicator OF cardiovascular and cerebrovascular events) cohort. It was found a precancerosis prevalence of 69.4% contributed to the epidemiological data of this population [72]. This instrument was validated regarding the discrimination between intrinsic versus extrinsic skin aging in a sample of 74 subjects which comprised regular sunbed users and non-sunbed users [65].

The reproducibility of the SCINEXA scale was studied in a South American non-Caucasian population of a region of Ecuador and revealed satisfactory results, despite the particular geographical region, the small sample size, and the possible influence of the genetic determinants of skin phenotypes that were not taken in to account [65,73].

3.3. Artificial Intelligence-Based Skin-Type Analysis

Artificial intelligence (AI) can be defined as the simulation of human intelligence by computer systems, based on machine learning. Artificial neural networks are complex algorithms that help the deep learning of machines to solve problems and generate an output [74]. AI was introduced into the medical field with the aim of assisting in diagnoses, as it can process a huge amount of data in a short time. In dermatology, it started with skin cancer analysis, since there is a large clinical, dermoscopic, and histopathological image database [19]. Other clinical applications of AI in dermatology include diabetic ulcers, atopic skin lesions, psoriasis, acne, vitiligo, or onychomycosis [74,75]. AI is able to help with the qualitative and quantitative analysis of lesion size, texture, or color with effective and accurate diagnostic results [76].

AI can be applied in cosmetology, for skin type or skin color analysis [77], to create aging and antiaging virtual images [78], or to show anticipated results of a cosmetic procedure [78–80]. Diamant et al. trained a generative model that generates faces conditioned on a requested beauty score, through Generative Adversarial Networks, achieving a ‘beautification’ learning process of face images [81].

Based on non-invasive biophysical parameters, Seo et al. created the basis for an AI skin classification system, providing reference values for the Korean population. The system will be more accurate as more data are added to the database [82].

Alagic et al. developed an artificial neural network for the analysis of facial skin health aiming at the construction of a decision-making tool for helping dermatologists in the diagnosis of skin problems. They created a database of 1000 participants in the study, 200 healthy volunteers, and 800 dermatological patients with problematic facial skin health conditions by assessing skin pH value, sebum, and transepidermal water loss. The authors manage to obtain an artificial neural network with high accuracy lacking a larger dataset to achieve efficient skin diagnosis [83].

The development of smartphone applications integrating image databases and algorithms has emerged during the pandemic period leading to the general availability of specialist services through telemedicine [75]. For cosmetic use, several applications

have been developed, allowing self-assessment of skin needs, focused choices, and aiding providers to target their products [84]. Some cosmetic brands are investing in AI applications to customize their recommendations, such as L'Oréal (Vichy Skin Consult [80] or L'Oréal Virtual Try On [85]) and Neutrogena's Skin360 App [86]. For in-office use, the VISIA Skin Analysis System provides a complete skin type and skin features analyses such as pigmentation, wrinkles, texture, and pores, as well as several simulations for skin interventions [87].

AI has limitations when applied to clinical procedures: the need for large image databases and diagnose uniformization criteria; technical aspects of image acquisition and its quality; patient compliance and ethical problems of data protection [19,74,75].

3.4. Others

3.4.1. Sensitive Skin—Lactic Acid Stinging Test (LAST)

Fawkes et al. studied the extrinsic and intrinsic factors that trigger self-reported skin sensitivity, through a 167-item survey in the United Kingdom population. They confirmed the key signs and symptoms of sensitive skin described in the literature but could not find a defined pattern to characterize the condition. The reported skin sensitivity was also able to associate with external factors such as cold or windy weather, some clothes, and fabrics, as well as internal factors such as pre-existing skin conditions and atopy [88].

The diagnosis of sensitive skin can be performed by the Lactic Acid Stinging test (LAST). This test consists of applying a lactic acid solution on the right nasolabial fold with a cotton swab and applying a saline solution on the left side as a control. If a stinging sensation occurs, this reaction is likely to correspond to sensitive skin. The subjects are asked to rate the intensity of the stinging immediately after the application of the lactic acid solution, after 2.5 min and 5 min, using a 4-point scale (0 = none, 1 = mild, 2 = moderate, 3 = strong). In the end, the sum of the scores given is calculated, so individuals with an overall LAST score ≥ 3 have sensitive skin. However, this test has disadvantages that are related to the unpleasant sensations caused [89].

LAST for sensitive skin evaluation was used to demonstrate treatment efficacy in several skin-sensitive conditions [90] and related pathologies such as rosacea [91,92] and atopic dermatitis [93].

Some external factors may interfere with the LAST results. Ye et al. studied the influence of seasons, facial regions, skin phototype, and living habits on the skin-sensitive diagnostic by the LAST score, in 24 healthy volunteers. The results showed increased scores in autumn, and varied with sleep time and spice ingestion, revealing that probably these factors should be taken into account when skin sensitivity is assessed [94].

Besides lactic acid, capsaicin [95] and sodium lauryl sulphate [96] were also used as models for assessing sensitive skin by the evaluation of the sensation of stinging or burning, respectively.

Ma et al. developed a method based on reflectance confocal microscopy to evaluate skin sensitivity and found skin patterns related to a positive LAST score that may be new signs of quantitative diagnosis and help to define the sensitive skin condition [97].

Misery et al. proposed a 10-item questionnaire for sensitive skin (the sensitive scale-10) to assess the condition severity and performed the correlation to the Dermatology Life Quality Index. The study occurred in 11 countries and included 2966 diagnosed skin-sensitive patients. The authors obtained a scale with an internal consistency that can measure the severity of sensitive skin, but it was not tested for its reproducibility and reliability [98].

A self-assessment questionnaire was developed by Corazza et al. to facilitate sensitive skin diagnosis for the patients. The authors manage to correlate the self-questionnaire and LAST results and determined a cut-off value to find LAST-positive individuals, and maybe turn it into a reliable tool for clinical diagnosis [99].

3.4.2. The Skin Color Charts/Cards/Bars

These are simple and economic methods that are also used to determine the skin's phototype, in which the individual chooses the color that is closest to their skin tone on the superior part of their arm [9].

The reference skin color chart was created by Felix von Luschan for racial classification purposes [100]. The Fitzpatrick scale, created to evaluate individual skin phototypes, has the disadvantage of being more suited to Caucasian skin and less suited to darker skin tones [35].

The lack of similarity to the real skin color, lack of sensibility to detect color shades, and influence of environmental conditions in measurements are some of the factors that make it difficult to objectively assess skin color. In 2007, L'Oréal developed a new color chart, the Chromasphere[®], that covered almost all skin colors and was validated for Caucasian and Asian color skins [101].

Skin color can also be a manifestation of skin conditions, and color charts can be a means of evaluating the effectiveness of treatments, such as beta-thalassemia major [102] or acanthosis nigricans [103].

Nakashima et al. developed a self-reported skin color scale that revealed a moderate correlation between melanin content and erythema index [104]. Meanwhile, several attempts to create an objective and quantitative scale have been developed [105,106].

4. Conclusions

A careful and correct skin type classification is relevant because it helps select the most appropriate cosmetic products and supports clinical research. Knowing the skin type is also important before performing any medical or cosmetic procedures to select the most appropriate practice and predict and avoid skin reactions and post-procedure complications.

There is a wide variety of methods to classify skin types that evaluate different skin parameters such as non-invasive instrumental methods (bioengineering tools), visual and tactile methods, artificial intelligence-based analysis and more subjective methods such as instruments (visual rating scales and self-reported instruments). Although subjective, self-reported instruments can collect insight from individuals that cannot be obtained with objective measurements and can also provide information on past events thus supporting more personalized advice. Visual rating scales are also an invaluable resource to assess skin type and aging holistically. The usefulness of these instruments is however dependent on their psychometric validity. Some of the proposed instruments have been poorly validated or not validated at all.

With this review, cosmetologists and dermatologists can select the instruments that fit best their research aims or practices. The knowledge depicted in this review is also relevant to avoiding spending resources and time on the development of new instruments that do not bring novelty in relation to the existing ones. One possible direction of the research in this field is the development of more universal instruments which can facilitate the comparability of efficacy studies. The validation in larger samples and application of these instruments to individuals of different ethnicities and living in different geographic locations also needs further investigation. In the near future, these instruments will benefit from the integration of artificial intelligence and artificial neural network methods, improving the accuracy of the evaluation and reducing the subjectivity of skin parameters assessment.

Author Contributions: Conceptualization, I.F.A. and L.F.A.; writing—original draft preparation, J.F. and R.O.; writing—review and editing, I.F.A., R.O. and L.F.A.; supervision, I.F.A. and L.F.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The authors would like to acknowledge the support of FCT—Fundação para a Ciência e a Tecnologia, I.P., in the scope of the project UIDP/04378/2020 and UIDB/04378/2020 of the Research Unit on Applied Molecular Biosciences—UCIBIO and the project LA/P/0140/2020 of the Associate Laboratory Institute for Health and Bioeconomy—i4HB. This work was also supported by the project 47239—Cork2Cosmetic (NORTE-01-0247-FEDER-047239).

Conflicts of Interest: The authors declare no conflict of interest.

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