INTRODUCTION

The once subjective nature of dermatology has become more objective with the use of quantitative measures to assess patients’ skin, allowing for more accurate diagnosis, improved disease monitoring, and a greater ability to track efficacy of treatments. Objective methods to assess features of the skin include corneosurfometry for assessing skin dryness, spectral reflectance for measuring redness or spots, and capacitance to measure wrinkle depth.\(^1\)\(^-\)\(^3\) There are also skin analysis devices that use specialized software to analyze photographs of individuals’ faces.\(^4\)\(^-\)\(^6\)

The most commonly used skin analysis device in the field of dermatology is comprised of an imaging photo booth with a computer software program to assess various features of the skin.\(^4\) This device...
utilizes three types of light to capture high-resolution images of the skin. Standard incandescent light is used to assess wrinkles and pores, ultraviolet (UV) light is used to assess UV damage, and polarized light is used to assess redness and pigmented spots.5,6 While considered the standard for skin analysis in clinical research, this computer-based system requires specific equipment to function and can be costly, potentially limiting its use in clinical practice.

The objective of our study was to validate and compare a new skin analysis application that can be easily downloaded in the form of an online application on an iPad or iPhone, to the standard skin analysis device used in dermatologic research. The measurements of five facial characteristics (redness, texture, pores, wrinkles, and spots) were compared between the two devices.

2 | MATERIALS AND METHODS

In an outpatient academic dermatology practice, 50 patients were recruited within the month of June 2022. Inclusion criteria for recruitment included ≥15 years of age, oily, dry, or combination skin types, Fitzpatrick scores I through VI, and the ability to remove glasses and face coverings. Exclusion criteria included facial tattoos, sunburns, or significant facial scarring. The Institutional Review Board of Wake Forest University reviewed and approved the study (IRB #00085220). All participants signed an informed consent.

Two facial analysis systems were used: AI Skincare (Perfect Corporation), which is an online application that can be downloaded on either an iPad or iPhone, and VISIA® Complexion Analysis Model Generation 7 (Canfield Scientific, Inc), a computer-based analysis system that utilizes a facial imaging photobooth. The AI Skincare facial analysis system iOS application was downloaded onto a tablet (iPad Pro 12.9-inch, 2021, 5th Generation) with iOS 15.5. The tablet was positioned on a stand to be at face level. Participants were seated face forward to the tablet on a height-adjustable stool. Glasses and face coverings were removed. With eyes open and a neutral facial expression, the tablet application detected the participant’s face in the frame and took a picture automatically. The tablet’s front facing default camera settings with no flash were used for photography. The raw score was recorded for each of the five skin characteristics: “spots,” “wrinkles,” “redness,” “texture,” and “pores.” A lower raw score indicated less desirable skin characteristics.

In the same room, after pictures with the tablet application were completed, participants were guided to position themselves in the photobooth to be analyzed with the computer device. Participants centered their face in the booth and closed their eyes. Photographs from center, right, and left were taken and analyzed by the computer-based software. Only measurements from the front face images were recorded to match the orientation measured on the tablet application. The pictures were reviewed and if needed, adjustments to the areas being evaluated were made. Raw number scores were recorded for the following five skin characteristics, “spots,” “wrinkles,” “redness,” “texture,” and “pores.” A higher raw score indicated less desirable skin characteristics.

Test–retest reliability was measured for each device by taking consecutive images of the same individual within 1 min of each other in constant room conditions. The duration of each assessment, from beginning of image capture to analysis, was also measured for each device using a stopwatch.

2.1 | Statistics

To compare the inter-reliability of the facial analysis systems to one another, a total match rate and match rate for each skin characteristic.

![Figure 1](image-url) Algorithm used for ranking pairs of patients: an algorithm created in Microsoft Excel was used to determine participants with less desirable skin characteristics for each skin characteristic for both skin analysis systems.
were determined between both systems. First, participants were all compared with one another for a total of 1255 comparisons in each skin category and for each skin analysis system. The participant with the less desirable skin characteristic for each category was identified based on their raw score and recorded for each pair (Figure 1). Any pairs with identical raw scores were removed. For the tablet application, a total of three pairs (5v19, 31v33, 39v40) were removed in the "pore" skin characteristic category for having identical raw scores. For the computer analysis system, a total of six participants (4, 10, 13, 19, 23, and 41) had a raw score of 0 for "wrinkles," thus those 15 pairs were removed for the "wrinkles" skin characteristic category. A total of 1225 spots, 1210 wrinkles, 1225 redness, 1255 texture, and 1222 pore comparisons were available for matching amongst the two systems. The tablet's and the computer system's scores for

**FIGURE 2** Raw scores given for each patient with the scores from the tablet (y value) plotted as a function of scores from computer system device (x value) for five skin characteristics: (A) Redness, (B) Texture, (C) Pores, (D) Wrinkles, and (E) Spots.
each skin characteristic category were compared with one another to determine match rates. A total of 6107 comparisons were made. Pearson correlation coefficient was calculated to determine correlations between the two devices and between wrinkle score and age for each device. Test–retest reliability was measured using the intraclass correlation coefficient (ICC) and Cronbach’s alpha measure of internal consistency. All data were analyzed with SPSS Statistics 28.0.

3 | RESULTS

Patients were a mean age of 54.0 (15–83), 58% female, and 76% Caucasian. All Fitzpatrick skin types (I–VI) were represented in our cohort, with the majority of participants (58%) having type II skin, followed by type I skin (14%) and type V skin (10%). The tablet and the computer analysis system had a concordance rate of 67.7% (4135/6107) when comparing which individual in each pair had worse skin health. The highest agreement was in assessing texture (72.0%) and pores (68.2%). There was the lowest agreement in assessing redness (64%) and wrinkles (67%). When comparing raw scores between the tablet and the computer system, there was a moderate correlation between all features assessed, with the strongest correlation between the raw scores given for texture (\( r = 0.57, \ p < 0.0001 \)) and spots (\( r = 0.54, \ p < 0.0001 \), Figure 2). When assessing the relationship between patients’ raw score from the tablet for wrinkles and their age, there was a very strong correlation (Table 1, \( r = 0.79, \ p < 0.0001 \)). The correlation between patients’ raw score for wrinkles provided by the computer system and their age was much weaker (\( r = 0.26, \ p < 0.06 \), Figure 3). When comparing the length of time necessary to take photos of each patient and analyze their skin, the tablet required less time (8.31 seconds) compared with the computer system (177 seconds). The intraclass correlation coefficient (ICC) and Cronbach’s alpha were higher for the tablet (0.990 and 0.998, respectively, \( p < 0.001 \)) compared with the computer system (0.989 and 0.977, respectively, \( p < 0.001 \)); however, both devices had excellent test–retest reliability.

4 | DISCUSSION

The computer-based analysis system used in our study is the standard skin analysis device for clinical trials. It uses three types of lighting

| TABLE 1 | Correlation between the two devices for each skin characteristic measured and correlation between age and wrinkle score in each device. |
|---|---|---|---|---|
| \( a \) | \( b \) | \( r \) | \( p \) |
| Computer–tablet Redness | −0.510 | 74.01 | 0.398 | 0.004 |
| Computer–tablet Texture | −0.348 | 40.85 | 0.568 | <0.0001 |
| Computer–tablet Pores | −0.791 | 100.56 | 0.495 | 0.0002 |
| Computer–tablet Wrinkles | −0.608 | 63.09 | 0.408 | 0.003 |
| Computer–tablet Spots | −0.505 | 103.65 | 0.536 | <0.0001 |
| Age-wrinkles | Computer | Tablet | Computer | Tablet | Computer | Tablet | Computer | Tablet |
| 0.281 | −1.279 | −2.00 | 124.21 | 0.259 | 0.792 | 0.07 | <0.0001 |

Note: Linear regression equation is \( y = aX + b \), 'a' represents the regression coefficient and 'b' represents the intercept value. \( r \) is the correlation coefficient. \( p \) value of <0.05 has significance.

(A) | (B)
---|---
**(A)** Wrinkle Score vs. Age | **(B)** Wrinkle Score vs. Age

**FIGURE 3** Raw scores for wrinkle assessment plotted as a function of age measured by (A) tablet and (B) computer system device.
the tablet application both have excellent test–retest reliability (ICC (spots, wrinkles, redness, pores, texture). The computer system and megapixels); however, both are able to assess similar facial features resolution (15 megapixels) than the camera used with the tablet (12 megapixels). The computer with specialized software, whereas the tablet consists of an iOS application downloaded onto an iPad 2021 or iPhone 12. The computer system, also had worse perceived skin health with the tablet application ranked pairs of patients the same in terms of which had worse skin health 67% of the time.6 The tablet had a strong association between wrinkle score and age, with older individuals having a worse wrinkle score. Unlike the computer system, the tablet does not use flash photography and does not require patients to enter their age in prior to skin analysis, limiting texture smoothing and any potential bias in its assessment.

The tablet application utilized in our study may serve as a convenient, cost-effective, and clinic friendly tool to assess patients’ skin. It produces similar results to that of other validated skin analysis devices and may be more sensitive in detecting and quantifying wrinkles.

**FUNDING INFORMATION**
Perfect Corporation.

**CONFLICT OF INTEREST**
Dr. Steven R. Feldman has received research, speaking and/or consulting support from a variety of companies including Galderma, GSK/ Stiefel, Almirall, Leo Pharma, Baxter, Boehringer Ingelheim, Mylan, Celgene, Pfizer, Valeant, Taro, Abbvie, Cosmederm, Anacor, Astellas, Janssen, Lilly, Merck, Merz, Novartis, Regeneron, Sanofi, Novan, Parion, Quirient, National Biological Corporation, Caremark, Advance Medical, Sun Pharma, Suncare Research, Informa, UpToDate and National Psoriasis Foundation. He is founder and majority owner of www.DrScore.com and founder and part owner of Causa Research, a company dedicated to enhancing patients’ adherence to treatment. Madison K. Cook, Margaret A Kaszycki, Irma Richardson, and Sarah L. Taylor have no conflicts of interest to disclose.

**ETHICAL APPROVAL**
The Institutional Review Board of Wake Forest University reviewed and approved the study (IRB: 00085220). All participants signed an informed consent.

**DATA AVAILABILITY STATEMENT**
The data that support the findings of this study are available from the corresponding author upon reasonable request.

**ORCID**
Madison K. Cook https://orcid.org/0000-0002-8433-1653
Steven R. Feldman https://orcid.org/0000-0002-0090-6289
REFERENCES

1. Trojahn C, Dobos G, Lichterfeld A, Blume-Peytavi U, Kottner J. Characterizing facial skin ageing in humans: disentangling extrinsic from intrinsic biological phenomena. *Biomed Res Int*. 2015;2015:1-9. doi:10.1155/2015/318586

2. Callaghan TM, Wilhelm KP. A review of ageing and an examination of clinical methods in the assessment of ageing skin. Part 2: clinical perspectives and clinical methods in the evaluation of ageing skin. *Int J Cosmet Sci*. 2008;30(5):323-332. doi:10.1111/j.1468-2494.2008.00455.X

3. Stamatas GN, Zmudzka BZ, Kollias N, Beer JZ. In vivo measurement of skin erythema and pigmentation: new means of implementation of diffuse reflectance spectroscopy with a commercial instrument. *Br J Dermatol*. 2008;159(3):683-690. doi:10.1111/j.1365-2133.2008.08642.x

4. VISIA system: a possible tool in the cosmetic practice – PubMed. Accessed June 26, 2022. https://pubmed.ncbi.nlm.nih.gov.wake.idm.oclc.org/25607694/

5. Wang X, Shu X, Li Z, et al. Comparison of two kinds of skin imaging analysis software: VISIA® from canfield and IPP® from media cybernetics. *Skin Res Technol*. 2018;24(3):379-385. doi:10.1111/SRT.12440

6. Linming F, Wei H, Anqi L, et al. Comparison of two skin imaging analysis instruments: the VISIA® from canfield vs the ANTERA 3D®CS from Miravex. *Skin Res Technol*. 2018;24(1):3-8. doi:10.1111/SRT.12381

7. Tan J, Liu H, Leyden JJ, Leoni MJ. Reliability of clinician erythema assessment grading scale. *J Am Acad Dermatol*. 2014;71(4):760-763. doi:10.1016/J.JAAD.2014.05.044

8. Shoshani D, Markovitz E, Monstrey SJ, Narins DJ. The modified Fitzpatrick wrinkle scale: a clinical validated measurement tool for nasolabial wrinkle severity assessment. *Dermatol Surg*. 2008;34(Suppl 1):S85-S91. doi:10.1111/J.1524-4725.2008.34248.X

9. Lee JY, Kim YK, Seo JY, et al. Loss of elastic fibers causes skin wrinkles in sun-damaged human skin. *J Dermatol Sci*. 2008;50(2):99-107. doi:10.1016/J.JDERMSCI.2007.11.010

10. Akazaki S, Nakagawa H, Kazama H, et al. Age-related changes in skin wrinkles assessed by a novel three-dimensional morphometric analysis. *Br J Dermatol*. 2002;147(4):689-695. doi:10.1046/J.1365-2133.2002.04874.X

11. Fujimura T, Hotta M. The preliminary study of the relationship between facial movements and wrinkle formation. *Skin Res Technol*. 2012;18(2):219-224. doi:10.1111/J.1600-0846.2011.00557.X

12. Efficacy and tolerability of kinetin 0.1% cream for improving the signs of photoaging in facial and neck skin | MDedge Dermatology. Accessed July 8, 2022. https://www.mdedge.com/dermatology/article/68985/aesthetic-dermatology/efficacy-and-tolerability-kinetin-01-cream-improving

13. Wanitphakdeedecha R, Meeprothom W, Manuskiatti W. Efficacy and safety of 0.1% kinetin cream in the treatment of photoaging skin. *Indian J Dermatol Venereol Leprol*. 2015;81(5):547. doi:10.4103/0378-6323.157446

How to cite this article: Cook MK, Kaszycki MA, Richardson I, Taylor SL, Feldman SR. Comparison of two devices for facial skin analysis. *J Cosmet Dermatol*. 2022;21:7001-7006. doi: 10.1111/jocd.15434