Development and validation of the fingertip unit for assessing Facial Vitiligo Area Scoring Index

Jung Min Bae, MD, PhD,[a] Raheel Zubair, MD, MHS,[b] Hyun Jeong Ju, MD,[a] Indermeet Kohli, PhD,[b] Han Na Lee, MS,[a] Sung Hye Eun, MD,[a] Alexis B. Lyons, MD,[b] Gautham Vellaichamy, BS,[b] Tae Young Han, MD, PhD,[c] Henry W. Lim, MD,[b] and Iltefat H. Hamzavi, MD[b]
Suwon and Seoul, Korea; Detroit, Michigan

Background: Facial involvement of vitiligo is an important factor in a patient's life and has often been evaluated separately from body surface area in clinical trials. However, no reliable tools to measure facial vitiligo specifically are available thus far.

Objective: To develop and validate a practical instrument for assessing facial vitiligo.

Methods: The ratios of a hand to a fingertip unit (FTU) of 98 healthy volunteers (age range, 2-69 years) were calculated to define the FTU. Facial Vitiligo Area Scoring Index was measured as the sum of all FTUs of each vitiligo lesion on the face (range, 0-112 FTU). In the validation study, 6 raters evaluated 11 patients with facial vitiligo twice at an interval of 2 weeks.

Results: One hand was measured at 32.1 ± 1.3 FTU, which was highly consistent among subjects across different age groups, sexes, and races. Facial Vitiligo Area Scoring Index showed remarkably high accuracy (concordance correlation coefficient, 0.946; smallest detectable change, 2.2 FTU) as well as high intrarater reliability (intraclass correlation coefficient, 0.903; inter-rater reliability, 0.903).

Limitations: Lack of dynamic validation of responsiveness.

Conclusion: Facial Vitiligo Area Scoring Index using the FTU is an intuitive, precise, and reliable instrument for assessing the extent of facial involvement in vitiligo patients. (J Am Acad Dermatol 2022;86:387-93.)

Key words: assessment; BSA; FTU; measurement; outcome; treatment response; VASI.

INTRODUCTION

Vitiligo is a common depigmentation skin disorder affecting around 1% of the population.[1,2] While vitiligo is not fatal, painful, or itchy, it has a major impact on the quality of life of affected patients.[3] Facial involvement of vitiligo is an important factor in many patients' lives[4]; thus, appropriate assessment of facial vitiligo is clinically relevant.

There are currently several tools used to assess the extent of vitiligo involvement, but no gold standard exists.[5] The most widely cited tool, the Vitiligo Area Scoring Index (VASI), uses the hand unit to assess the affected body surface area (BSA).[6] VASI has been found to have high inter- and intrarater reliabilities; however, detecting fine differences in depigmentation is often difficult and cumbersome.[7]

From the Department of Dermatology, St. Vincent's Hospital, College of Medicine, The Catholic University of Korea, Suwona[a]; Department of Dermatology, Henry Ford Hospital, Detroit[b]; and Department of Dermatology, Eulji General Hospital, Eulji University.[c]
Drs Bae, Zubair, and Ju contributed equally to this work.
Funding: None.
IRB approval status: The protocol was approved by the institutional review boards of St. Vincent's Hospital (VC18RESI0274) and Henry Ford Hospital (IRB No: 11728).

Accepted for publication June 25, 2021.
Correspondence and reprint requests to: Iltefat Hamzavi, MD, Department of Dermatology, Henry Ford Medical Center, 3031 W Grand Blvd, Suite 800, Detroit, MI 48202.. E-mail: amiller5@hfhs.org.
Published online July 9, 2021.
0190-9622/$36.00

https://doi.org/10.1016/j.jaad.2021.06.880

The Vitiligo Extent Score is another validated instrument for assessing vitiligo involvement, but it can be challenging to evaluate small vitiligo lesions precisely.[8] Many vitiligo patients have scattered depigmented patches much smaller than the size of 1 finger, and the impact of small facial vitiligo lesions on patients is not trivial.[9] Nonetheless, it is difficult to assess the extent of vitiligo in such patients using the currently available instruments.

The hand unit has been widely used as a reference tool for estimating the BSA involved in burns and various skin diseases.[10] It consists of the palmar surface of the digits and it is a good approximation of 1% BSA, although it is not actually 1% of the total BSA.[11] It is of less utility when evaluating skin lesions smaller than the size of the palm, however, especially in the case of vitiligo. The fingertip unit (FTU) in dermatology has been conventionally used as a tool to explain an appropriate amount of topical medication to be applied to prevent the patients from using excessive amount of topical steroid.[12]

In this study, we devised the FTU, conceptualized as the area between the joints of the phalanges, as a measurement unit to assess the extent of facial vitiligo more precisely. We also developed and validated the FTU for measuring the Facial Vitiligo Area Scoring Index (F-VASI). The definition of F-VASI used in this study is the sum of all FTUs needed to measure all vitiligo lesions on the face.

CAPSULE SUMMARY

- Facial Vitiligo Area Scoring Index using the fingertip unit can reliably and easily assess the extent of vitiligo facial involvement.
- Facial Vitiligo Area Scoring Index using the fingertip unit can not only improve patient care in clinical practice but also enhance the quality of clinical research.

METHODS

Determination of the FTU

A total of 98 healthy volunteers (39 males and 59 females; age range, 2-69 years) were enrolled in Suwon (Korea) and Detroit (United States) between January 2018 and August 2018. The subjects consisted of 22 children (0-12 years), 12 adolescents (13-18 years), and 64 adults (19 years or older). By self-identified race, there were 65 Asian, 14 White, 12 Black, and 7 Native American patients.

The palmar aspects of their hands were photographed and the surface areas of the hand, the index, middle, and ring fingers were measured using the ImageJ software (https://imagej.nih.gov/). One FTU was calculated using the total area of the index, middle, and ring fingers to represent 9 FTU. The ratios of the hands and fingers to the FTU, respectively, were calculated.

Development of F-VASI using the FTU

The definition of F-VASI used in this study is the sum of all fingertip units needed to measure all vitiligo lesions on the face. We further converted a fingertip, finger, or hand into FTUs and used them to assess the area of each patch. If repigmentation occurs, F-VASI can alternatively be calculated by the product of FTU multiplied by the depigmentation level of each vitiligo lesion. The depigmentation level can take a value between 0 and 1, either by a rough estimate or by selecting the most similar one from the reference image, which was established using ImageJ software (National Institutes of Health).[13]

Pilot study of F-VASI

A pilot study was conducted between March 2019 and June 2019. A total of 41 dermatologists and dermatology trainees were recruited in Suwon, Seoul (Korea), and Detroit (United States). Two sessions of F-VASI evaluation using the FTU were performed, based on the pictures of 17 patients with facial vitiligo at 2-week interval. All assessments were conducted online using Google Forms (Google).

Validation study of F-VASI

In the validation study, live patient evaluations were conducted between December 2020 and January 2021. A total of 6 raters, including 2 vitiligo experts, 2 dermatologists, and 2 dermatology trainees, evaluated F-VASI using the FTU on 11 live patients of facial vitiligo (3 males and 8 females; age range, 27- 79 years). The second live evaluation session was conducted 2 weeks after the first session to evaluate the intrarater reliability of F-VASI.

Statistical analysis

To determine the FTU, differences in the ratios of hand and palm areas to the fingertip area among various age groups, sexes, and races were analyzed using one-way analysis of variance and independent *t* test. In the validation study of F-VASI, the sample size was calculated based on the pilot study using the equation proposed by Walter et al.[14]

The value of alpha (α) was prespecified to be 0.05 and the value of the intraclass correlation coefficient (ICC) of the null hypothesis (R_0) was prespecified to be 0.6, meaning there is already a certain amount of agreement between ratings. Expected reliability (R_1)

Abbreviations used:

BSA: body surface area
CCC: concordance correlation coefficient
CI: confidence interval
FTU: fingertip unit
F-VASI: Facial Vitiligo Area Scoring Index
ICC: intraclass correlation coefficient
SDC: smallest detectable change
VASI: Vitiligo Area Scoring Index

was prespecified to be 0.9, and the raters (k) were set as 5. The equation led to 9 sample sizes needed (5 raters and 9 subjects). Considering follow-up loss, 6 raters and 11 subjects were included in the study.

The accuracy was assessed by calculating concordance correlation coefficients (CCC) between the digital assessment (reference values established by ImageJ) and each measurement.[15] The smallest detectable change (SDC) was calculated as $SDC_{95} = 1.96 \times \sqrt{2} \times$ the standard error of measurement, where standard error of measurement = standard deviation $\times \sqrt{(1 - \text{coefficient})}$.[8,16] Inter- and intrarater reliabilities were assessed by deriving intraclass correlations (ICC).[17] All analyses were performed using R software (ver. 3.6.0; R Foundation for Statistical Computing).

RESULTS

Establishment of the FTU

One FTU was defined as one-ninth of the combined palmar area of the second, third, and fourth digits of the hand. There are 9 inter-joint spaces in this area; thus, 1 FTU represents an average. Image analysis of the palmar aspect of the hands of 98 healthy volunteers showed that 1 hand equals 32.1 ± 1.3 FTU (mean ± standard deviation), and these ratios were highly consistent among subjects, across age groups, sexes, and races (Table I). Therefore, lesion area can be estimated using a combination of the following units, depending on the lesion size: a fingertip (1 FTU), a finger (3 FTU), a thumb (3 FTU), or a hand (32 FTU) (Table II; Fig 1).

Pilot study

In the pilot study, pictures of 17 patients with facial vitiligo were scored with high intrarater reliability (ICC, 0.926; 95% confidence interval [CI], 0.915-0.936) between the first and second sessions of assessment. In the first session of assessment, F-VASI brought an acceptable inter-rater reliability (ICC, 0.861; 95% CI, 0.772-0.936), which improved in the second session of assessment (ICC, 0.909; 95% CI, 0.846-0.959) (Table III).

Table I. Ratio of hand area to fingertip unit by demographic group

Variable	n	FTU per hand (mean ± SD)	*P* value*
Total	98	32.1 ± 1.3	
Age group			.219
Children	22	32.0 ± 1.1	
Adolescent	12	31.7 ± 0.8	
Adult	64	32.3 ± 1.4	
Gender			.790
Male	39	32.1 ± 1.3	
Female	59	32.2 ± 1.3	
Race			.896
Asian	65	32.2 ± 1.4	
White	14	32.1 ± 1.3	
Black	12	32.0 ± 1.2	
Native American	7	32.3 ± 0.8	

FTU, Fingertip unit; *n*, number of patients; *SD*, standard deviation.
*One-way analysis of variance test or independent *t* test was conducted.

Table II. Conversion between fingertip unit, percent face surface area, and percent body surface area

Anatomic region	FTU	FSA	BSA
1/2 fingertip	0.5	0.45%	0.015%
1 fingertip	1	0.9%	0.03%
2 fingertips	2	1.8%	0.06%
1 finger	3	2.7%	0.1%
1 thumb	3	2.7%	0.1%
2 fingers	6	5.4%	0.2%
3 fingers	9	8.1%	0.3%
1 hand	32	28.6%	1%
1.5 hand	48	42.8%	1.5%
2 hands	64	57.1%	2%
1 face	112	100%	3.5%

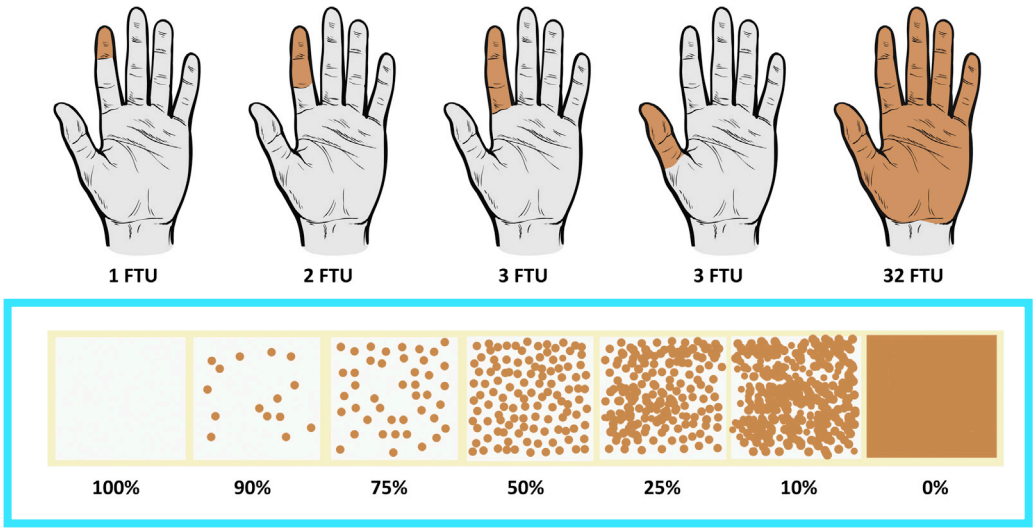
BSA, Body surface area; *FSA*, face surface area; *FTU*, fingertip unit.

Accuracy of F-VASI using the FTU

In the live validation study, F-VASI showed remarkably high accuracy in terms of CCC (0.946; 95% CI, 0.913-0.967) in the second session of assessment (Table III; Fig 2). The accuracy improved over the first session of assessment (CCC, 0.915; 95% CI, 0.865-0.946) performed 2 weeks earlier. The SDC also improved to 2.2 FTU in the second session of assessment compared to the 4.1 FTU in the first session.

Inter- and intrarater reliability of F-VASI

In the live validation study, F-VASI yielded a remarkably high intrarater reliability (ICC, 0.903; 95% CI, 0.847-0.940) between the first and second sessions of assessment. In the first session of



$$F-VASI=\sum[FTU]\times[Residual\ depigmentation\ rate]$$

$$FSA(\%)=FTU\times 0.7$$

$$BSA(\%)=FTU\times 0.03$$

Fig 1. The fingertip unit (FTU) and F-VASI. Vitiligo lesions can be estimated by using a fingertip (1 FTU), a finger (3 FTU), a thumb (3 FTU), or a hand (32 FTU), depending on the lesion size. If repigmentation appears, the level of perifollicular repigmentation could be applied to the FTU in each area by multiplying by depigmentation level. F-VASI is defined as the sum of all FTUs of each vitiligo lesion on the face. FTU can be converted to FSA (%) and BSA (%). *BSA*, Body surface area; *F-VASI*, Facial Vitiligo Area Scoring Index; *FSA*, face surface area.

Table III. Summary of the study for the Facial Vitiligo Area Scoring Index using the fingertip unit to assess the extent of vitiligo facial involvement

Accuracy		Raters (n)	Evaluation	Cases (n)	CCC (95% CI)	SDC_{95}
Pilot study	First session	41	Pictures	17	0.904 (0.889-0.916)	3.8 FTU
	Second session	41	Pictures	17	0.937 (0.927-0.945)	2.0 FTU
Validation study	First session	6	Live patients	11	0.915 (0.865-0.946)	4.1 FTU
	Second session	6	Live patients	11	0.946 (0.913-0.967)	2.2 FTU

Intrarater reliability	Raters (n)	Evaluation	Cases (n)	ICC (95% CI)
Pilot study	41	Pictures	17	0.926 (0.915-0.936)
Validation study	6	Live patients	11	0.903 (0.847-0.940)

Inter-rater reliability		Raters (n)	Evaluation	Cases (n)	ICC (95% CI)
Pilot study	First session	41	Pictures	17	0.861 (0.772-0.936)
	Second session	41	Pictures	17	0.909 (0.846-0.959)
Validation study	First session	6	Live patients	11	0.857 (0.717-0.952)
	Second session	6	Live patients	11	0.903 (0.794-0.968)

CCC, Concordance correlation coefficient; *CI*, confidence interval; *FTU*, fingertip unit; *ICC*, intraclass correlation; *n*, number; *SDC*, smallest detectable change.

assessment, F-VASI brought an acceptable inter-rater reliability (ICC, 0.857; 95% CI, 0.717- 0.952), which improved in the second session of assessment (ICC, 0.903; 95% CI, 0.794-0.968).

DISCUSSION

In the present study, we devised the FTU as a new measurement subunit for F-VASI in terms of measurement precision. Using FTU, F-VASI has a great accuracy (CCC, 0.946; SDC, 2.2 FTU) as well as high intrarater (ICC, 0.903) and inter-rater reliabilities (ICC, 0.903). Both the hand and fingertip are intuitive and readily available internal reference standards for the assessment of surface area. The FTU, however, is unique in that it can measure a small surface area more precisely and easily and can be conveniently

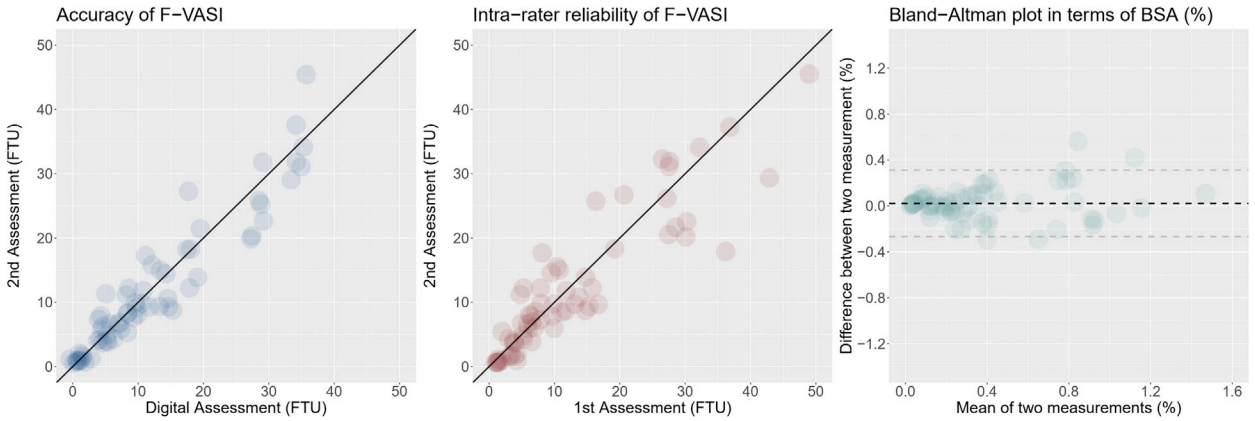


Fig 2. Accuracy of F-VASI, intrarater reliability, and Bland-Altman plot of the validation study for the Facial Vitiligo Area Scoring Index (F-VASI) using the fingertip unit (FTU). *BSA*, Body surface area.

converted or communicated. Despite its clinical significance, there are no clinical outcome tools with this level of precision for facial vitiligo currently available. Measuring F-VASI utilizing the FTU could satisfy this unmet need.

Because individuals have different finger and face sizes, an evaluation using the patient's own fingers is inherently less accurate than digital image analysis systems. However, F-VASI using the FTU is precise, as the sizes of an individual's finger and face do not change appreciably. In other words, the FTU method provides a consistent outcome when used on the same patient over time. However, the accuracy could be limited when comparing the severity between individuals. Indeed, precision is more important than accuracy in clinical practice and clinical studies, because consistency of a measure is the desired function of the outcome measure.

Properly measuring the extent of facial involvement in patients with vitiligo is important in both daily practice and in clinical trials. When depigmentation occurs on the face, it causes significantly greater impairment in patients' quality of life[4,18] and is highly associated with anxiety and depression.[19]

Patients have stated that their face is the area of greatest concern.[20] Thus, facial vitiligo should be given more attention and evaluated independently from more widespread body involvement.[21] Fortunately, the face is an area that generally shows the best therapeutic response following various nonsurgical treatment options, including phototherapy and topical agents.[22,23] In real-life practice, many vitiligo patients are primarily concerned with their facial lesions and are often satisfied with the remarkable improvement of the face even if truncal lesions persist. Furthermore, recently introduced targeted agents, such as Janus kinase inhibitors, showed significant improvement mainly on sun-exposed areas, including the face and neck.[24-26] Therefore, it would be relevant to assess the face independently and in addition to the whole body when evaluating the treatment response of vitiligo.

Generally, the percent BSA is calculated using one's own hand, and this is not suitable especially for facial vitiligo when lesions are very small or scattered.[27] Under this approach, small lesions on the face will be expressed in hundredths of a percent, which is not practical for communication with patients or between clinicians. Most vitiligo patients have less than 10% involvement of the total face surface area.[21] In contrast, the FTU is more intuitive and easy to understand for patients and clinicians (eg, 2 FTU versus 0.06% BSA). Moreover, small percentages can make facial involvement seem trivial, despite its enormous significance to patients.[4]

For these reasons, the FTU is more relevant to facial vitiligo than in percent BSA. Because we confirmed that the ratio of fingertip area to total hand area is not much different across all age groups, sexes, and races, clinicians and researchers can use the FTU in any patient population. F-VASI using the FTU is better suited to evaluate scattered vitiligo lesions with various sizes around complex facial structures, such as the eyes, nose, and mouth. Using a patient's own FTU can be expanded in the assessment of relatively small areas, such as the genitals and dorsal aspect of hands and feet.

F-VASI using the FTU allows clinicians a readily available tool without any preparation in clinical settings. The improved accuracy of the second session over the first session in the validation study suggests that experience and training can improve the accuracy of F-VASI. In addition, F-VASI could be used to capture changes in facial vitiligo over time or

in response to treatment if combined with an assessment of the perifollicular depigmentation level. By doing so, it might also have the potential to serve as a dynamic evaluation to assess the change of repigmentation or disease progression, though further validation studies are needed.

The FTU approach can be used in conjunction with the traditional hand unit when assessing the surface areas. For assessing widespread vitiligo lesions throughout the face and whole body, F-VASI assessed using the FTU can be added to VASI measurement by converting FTU to % BSA (% BSA = FTU × 0.03; Table II, Fig 1). There is also potential to apply the FTU concept to measuring other locations, such as genitalia. Moreover, it can also be considered for various skin disorders other than vitiligo, such as scars and wounds.

There are several limitations to using the FTU method. First, we assumed that the hand surface area represents 1% of the total BSA, but this percentage would actually be larger in children and smaller in overweight adults.[11] Therefore, the FTU method could under- or overestimate the affected BSA in these groups. Second, it may not be as accurate as a digital image analysis system that algorithmically quantifies depigmentation. Third, 1 FTU was initially derived using the average of index, middle, and ring fingers, but these digits are not the same size. The ratio of index to ring finger is sexually dimorphic and is influenced by prenatal androgen exposure.[28] The middle finger is longer than both the ring finger and the index finger. Fourth, it is difficult to use the FTU method in subjects with conditions such as hand deformities, amputations, or skeletal and growth disorders. Furthermore, the FTU method would be less feasible in patients with extensive vitiligo lesions, so the combination of hand unit and FTU may be more appropriate, depending on the size of the lesion. Fifth, the FTU approach was not validated for responsiveness to treatment in this study. However, F-VASI using the FTU is intuitive and expeditious and will be useful for most vitiligo patients with small facial lesions.

CONCLUSION

The FTU is a practical and precise measurement unit for assessing the extent of facial involvement in patients with vitiligo (F-VASI). It not only allows for more precise assessments of small focal lesions on the face or genital area but can also complement VASI measurement of widespread vitiligo through proper conversion. Because the FTU is a smaller unit compared to the conventional hand unit, it is represented by whole numbers, which has the advantage of being intuitive and understandable to clinicians and patients. Moreover, it is relevant in that it reflects the fact that even tiny white patches on the face are nontrivial for vitiligo patients. It can be used as a quick assessment of the surface area in clinical practice and to enhance the quality of clinical research.

The authors thank all patients and participants in this study.

Conflicts of interest

Dr Hamzavi is an investigator for Incyte, Bayer, Estee Lauder, Unigen, and Ferndale Healthcare. Dr Lim is an investigator for Incyte, Estee Lauder, Unigen, and Ferndale Healthcare. Dr Kohli is a subinvestigator for Bayer, Estee Lauder, Unigen, and Ferndale Healthcare. Dr Lyons is a subinvestigator for Incyte, Bayer, Estee Lauder, and Unigen. Dr Bae is an investigator for Pfizer and GSK. Drs Zubair, Han, Ju, and Eun and Ms Lee and Mr. Vellaichamy have no conflicts of interest to disclose.

REFERENCES

1. Lee H, Lee MH, Lee DY, et al. Prevalence of vitiligo and associated comorbidities in Korea. *Yonsei Med J*. 2015;56(3):719-725.
2. Richard MA, Corgibet F, Beylot-Barry M, et al. Sex- and age-adjusted prevalence estimates of five chronic inflammatory skin diseases in France: results of the << OBJECTIFS PEAU >> study. *J Eur Acad Dermatol Venereol*. 2018;32(11):1967-1971.
3. Elbuluk N, Ezzedine K. Quality of life, burden of disease, co-morbidities, and systemic effects in vitiligo patients. *Dermatol Clin*. 2017;35(2):117-128.
4. Florez-Pollack S, Jia G, Zapata L Jr, et al. Association of quality of life and location of lesions in patients with vitiligo. *JAMA Dermatol*. 2017;153(3):341-342.
5. Eleftheriadou V, Thomas KS, Whitton ME, Batchelor JM, Ravenscroft JC. Which outcomes should we measure in vitiligo? Results of a systematic review and a survey among patients and clinicians on outcomes in vitiligo trials. *Br J Dermatol*. 2012;167(4):804-814.
6. Hamzavi I, Jain H, McLean D, Shapiro J, Zeng H, Lui H. Parametric modeling of narrowband UV-B phototherapy for vitiligo using a novel quantitative tool: the Vitiligo Area Scoring Index. *Arch Dermatol*. 2004;140(6):677-683.
7. Komen L, da Graca V, Wolkerstorfer A, de Rie MA, Terwee CB, van der Veen JP. Vitiligo Area Scoring Index and Vitiligo European Task Force assessment: reliable and responsive instruments to measure the degree of depigmentation in vitiligo. *Br J Dermatol*. 2015;172(2):437-443.
8. van Geel N, Lommerts J, Bekkenk M, et al. Development and validation of the Vitiligo Extent Score (VES): an international collaborative initiative. *J Invest Dermatol*. 2016;136(5):978-984.
9. Bae JM, Lee SC, Kim TH, et al. Factors affecting quality of life in patients with vitiligo: a nationwide study. *Br J Dermatol*. 2018;178(1):238-244.
10. Rossiter ND, Chapman P, Haywood IA. How big is a hand? *Burns*. 1996;22(3):230-231.
11. Rhodes J, Clay C, Phillips M. The surface area of the hand and the palm for estimating percentage of total body surface area: results of a meta-analysis. *Br J Dermatol*. 2013;169(1):76-84.
12. Finlay AY, Edwards PH, Harding KG. "Fingertip unit" in dermatology. *Lancet*. 1989;2(8655):155.
13. Bae JM, Oh SH, Kang HY, et al. Development and validation of the Vitiligo Extent Score for a Target Area (VESTA) to assess

the treatment response of a target lesion. *Pigment Cell Melanoma Res*. 2019;32(2):315-319.
14. Walter SD, Eliasziw M, Donner A. Sample size and optimal designs for reliability studies. *Stat Med*. 1998;17(1):101-110.
15. Lin LI. A concordance correlation coefficient to evaluate reproducibility. *Biometrics*. 1989;45(1):255-268.
16. de Vet HC, Terwee CB, Ostelo RW, Beckerman H, Knol DL, Bouter LM. Minimal changes in health status questionnaires: distinction between minimally detectable change and minimally important change. *Health Qual Life Outcomes*. 2006;4:54.
17. Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *J Chiropr Med*. 2016;15(2):155-163.
18. Silverberg JI, Silverberg NB. Quality of life impairment in children and adolescents with vitiligo. *Pediatr Dermatol*. 2014;31(3):309-318.
19. Bilgic O, Bilgic A, Akis HK, Eskioğlu F, Kiliç EZ. Depression, anxiety and health-related quality of life in children and adolescents with vitiligo. *Clin Exp Dermatol*. 2011;36(4):360-365.
20. Eleftheriadou V, Hamzavi I, Pandya AG, et al. International Initiative for Outcomes (INFO) for vitiligo: workshops with patients with vitiligo on repigmentation. *Br J Dermatol*. 2019;180(3):574-579.
21. Bae JM, Jung YS, Jung HM, Park JH, Hann SK. Classification of facial vitiligo: a cluster analysis of 473 patients. *Pigment Cell Melanoma Res*. 2018;31(5):585-591.
22. Bae JM, Jung HM, Hong BY, et al. Phototherapy for vitiligo: a systematic review and meta-analysis. *JAMA Dermatol*. 2017;153(7):666-674.
23. Lee JH, Kwon HS, Jung HM, et al. Treatment outcomes of topical calcineurin inhibitor therapy for patients with vitiligo: a systematic review and meta-analysis. *JAMA Dermatol*. 2019;155(8):929-938.
24. Liu LY, Strassner JP, Refat MA, Harris JE, King BA. Repigmentation in vitiligo using the Janus kinase inhibitor tofacitinib may require concomitant light exposure. *J Am Acad Dermatol*. 2017;77(4):675-682.e1.
25. Rothstein B, Joshipura D, Saraiya A, et al. Treatment of vitiligo with the topical Janus kinase inhibitor ruxolitinib. *J Am Acad Dermatol*. 2017;76(6):1054-1060.e1.
26. Joshipura D, Plotnikova N, Goldminz A, et al. Importance of light in the treatment of vitiligo with JAK-inhibitors. *J Dermatolog Treat*. 2018;29(1):98-99.
27. Waslen GD. Management of outpatient burns. *Can Fam Physician*. 1986;32:805-808.
28. McIntyre MH. The use of digit ratios as markers for perinatal androgen action. *Reprod Biol Endocrinol*. 2006;4:10.