ORIGINAL RESEARCH

Comparisons of Four Acne Grading Systems Recommended in China, Korea, and Japan

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Introduction: Acne vulgaris is one of the most prevalent skin disorders. The treatment regimen depends on how severe the AV is. The acne grading system is crucial for clinical and research work. The aim of this work was to evaluate intra-grader differences between 5 investigators using Acne Grading System (AGS), the International Improved Grading System (IIGS), the Korean Acne Grading System (KAGS), and the Japanese Acne Grading System (JAGS) to assess acne vulgaris (AV) severity.

Patients and Methods: AV sufferers from dermatological clinics of five hospitals in China were the subject of a prospective cross-sectional study. AGS, IIGS, KAGS and JAGS were utilized by 5 investigators to verify the severity of AV. The correlation between AGS, IIGS, KAGS and JAGS was examined.

Results: A complete of 1107 AV sufferers were enrolled in the study. There were indications that the AGS, IIGS, KAGS and JAGS had sufficient internal consistency. As for the reliability amongst raters, AGS, IIGS, KAGS and JAGS confirmed gorgeous reliability. There were strong correlations amongst AGS, IIGS, KAGS and JAGS (P≤0.01). The interior reliability of investigator 1 one year ago and later after usage of AGS and IIGS was excellent (P≤0.01).

Conclusion: IIGS and AGS exhibited great correlation with KAGS and JAGS and were highly reliable.

Keywords: acne vulgaris, acne grading system, assessment, severity

Introduction

Acne vulgaris (AV) is one of the most prevalent inflammatory skin diseases that affect young adults and even females over the age of 25.[1] AV affects approximately 9% of the people worldwide, and adolescent prevalence ranges from 88% to 94%.[2,3] It may result in melancholy, nervousness, self-deprecation, psychiatric hospitalizations, school absenteeism, unemployment, and suicidality.[4,5] Four factors contributed to the pathogenesis of AV: follicular colonization by *Propionibacterium acnes* (*P. acnes*), altered keratinization processes that lead to the development of comedones, inflammatory mediators around the pilosebaceous unit, and increased sebum production.[6] The treatment approach depends on the severity of the AV, as the guidelines of countries around the world. It is frequently treated with over-the-counter topical treatments for mild patients, and moderate-to-severe ones may sometimes require the prescription of oral and topical medications such antibiotics, topical retinoids, and oral contraceptives.[7,8] Hence, simple, accurate, and speedy evaluation tools applied to determine the severity of AV was an ideal choice. Each of these assessment tools placed a different emphasis on the quantity and/or types of acne lesions. Moreover, it takes time to count and categorize various types of lesions. Additionally, the reliability of raters varies amongst dermatologists, and the same dermatologist may give the same patient various grades at different times.

A minimum of 25 scales have been published to evaluate the severity of AV; however, none of them meet universal standards.[9,10] As a result, many countries advised using different assessment tools: (1) Global Acne Grading System (GAGS) was the one of the most frequently used assessment tools, which was applied in many studies conducted in Africa and other continents.[11,12] (2) Grading Scale for overall severity (GSOS) was an evolution of the GAGS, which

graded only on the facial area and was applied in the Australia;[13] (3) the US Food and Drug Administration (FDA) and Europe encouraged the Global Assessment of Acne (IGA) and the Global Assessment of Acne (GEA) scale respectively;[14–17] (4) The grading tools used in China were the International Improved Grading System (IIGS) advocated in the textbook of Chinese Clinical Dermatology edited by Zhao Bian and the acne grading system (AGS), which was stated in the Acne Diagnosis and Treatment Guide of China;[17,18] (5) Korea Acne Grading System (KAGS) and Japan Acne Grading System (JAGS) were utilized in Korea and Japan respectively.[19,20]

Every AV evaluation tool has benefits and drawbacks. The type and quantity of lesions are considered by GAGS, GOGS, IGA, GEA, IIGS, KAGS, and JAGS except IGA. The difference is that while GAGS, GOGS, IGA and GEA rely on a semiquantitative quantity of lesions, described by "few", "a few", "some", and "many", IIGS, KAGS, and JAGS are on a quantitative quantity of lesions and are characterized by using values. AGS is simpler and quicker than the other five ones because it only recognizes the type of lesion. Since IGA and GEA have been investigated by our team in another study, and the Chinese are ethnically related to the Japanese and Koreans, AGS, IIGS, KAGS, and JAGS were chosen for this study.[21]

This study was to examine the consistency of 5 investigators who used the AGS, IIGS, KAGS, and JAGS to evaluate the severity of AV. This second goal was to compare the internal consistency of investigator 1 before and after a year of utilizing AGS and IIGS.

Patients and Methods
Study Participants
A total of 5 hospitals in China including First Affiliated Hospital of Chongqing Medical University in Chongqing, China–Japan Friendship Hospital and Air Force Medical Center in Beijing, RENJI Hospital and Shanghai Ninth People's Hospital in Shanghai, selected AV patients from their dermatology clinics. The study was performed from March 2019 until February 2020. Take VISIA photos of AV sufferers on their initial visit. The China–Japan Friendship Hospital's ethics committee gave the study their blessing (2020–130-K83). The study complied with the Declaration of Helsinki. Patients who participated in this study signed written informed consent.

Tools for Assessing AV Severity
Five dermatologists were involved in assessing the AV severity. All had 24-hour training before evaluation began. Training items cover the use of scoring systems, classifications of AV lesion types, and counting lesions. The psychometric property of the 4 evaluation scales was not observed. The AV severity was determined individually by each investigator using an acne grading system every time. AV grading systems were employed as previously mentioned.[19–21]

Analytical Statistics
Microsoft Excel and the Statistical Package for the Social Sciences (SPSS) version 18.0 were employed to analyze the data. The sample size was determined by the Mace Medical software version 6.2.1 under the presumption that there was no correlation between the four tools ($\alpha=0.05$, $\beta=0.95$). The Shapiro–Wilk test was performed to examine the normality of the continuous variables. AGS, IIGS, KAGS, and JAGS were compared to check if their distributions were the same by the Mann–Whitney U-test. Frequency and percentage phrases were used to express categorical variables. A reliability analysis was conducted between five investigators. The difference between the mean scores of 5 investigators using AGS, IIGS, KAGS, and JAGS was evaluated using the Pearson correlation analysis.

Results
AV Severity of Different Investigators Using Various Grading Systems
The sample size determined by Mace Medical software was less than or equal to 783 patients. This study included a total of 1107 patients, including 200 from the First Affiliated Hospital of Chongqing Medical University, 309 from the China–Japan Friendship Hospital, 197 from the Air Force Medical Center in Beijing, 199 from RENJI Hospital, and 202 from the Ninth People's Hospital. There were 785 women (77.19%) and 232 men (22.81%). As shown in Table 1, AGS, IIGS, KAGS and JAGS were applied to evaluate the participants. Of the participants, 27.4% were in grade 3, while 47.5% were in grade 2. The IIGS

Table 1 AV Severity of 5 Investigators Using AGS, IIGS, KAGS and JAGS

Methods	Investigators/Score	1(%)	2(%)	3(%)	4(%)	5(%)	6(%)
AGS	Investigator 1	11.9	39.3	24.2	24.6	/	/
	Investigator 2	11.3	42.8	32.3	13.7	/	/
	Investigator 3	7.5	59.9	22.1	10.5	/	/
	Investigator 4	10.4	52.5	26.1	11.0	/	/
	Investigator 5	8.3	43.2	32.4	16.1	/	/
	Mean	9.9±1.9	47.5±8.5	27.4±4.7	15.2±5.7	/	/
IIGS	Investigator 1	57.9	11.9	21.0	9.1	/	/
	Investigator 2	32.1	33.9	23.5	10.5	/	/
	Investigator 3	43.4	33.5	19.3	3.8	/	/
	Investigator 4	51.3	25.4	20.1	3.2	/	/
	Investigator 5	44.1	23.3	25.0	7.7	/	/
	Mean	45.8±9.7	25.6±9.0	21.8±2.4	6.9±3.2	/	/
KAGS	Investigator 1	35.6	34.1	28.4	1.9	/	/
	Investigator 2	29.8	36.4	26.6	6.0	1.1	0.1
	Investigator 3	23.0	32.6	43.0	1.3	0.1	/
	Investigator 4	41.9	38.4	12.9	4.2	2.2	0.4
	Investigator 5	18.6	29.7	46.9	4.2	0.6	
	Mean	29.7±9.4	34.2±3.4	31.6±13.7	3.5±1.9	/	/
JAGS	Investigator 1	32.7	40.9	19.3	7.1	/	/
	Investigator 2	25.4	41.1	27.3	6.2	/	/
	Investigator 3	17.7	37.2	30.1	15.0	/	/
	Investigator 4	34.4	34.3	22.6	8.7	/	/
	Investigator 5	19.3	39.5	32.4	8.8		
	Mean	25.9±7.6	38.6±2.8	26.3±5.4	9.2±3.4		

graded 45.8% of the participants as being in grade 1. The percentage of participants using KAGS to evaluate them is nearly identical in grades 1 through 3 (29.7% at grade 1, 34.2% at grade 2, and 31.6% at grade 3). The majority of individuals who underwent JAGS evaluations were in grades 1 through 3 (25.9% were in grades 1, 38.6% were in grades 2, and 26.3% were in grades 3). The frequencies of scores determined by five independent investigators utilizing the AGS, IIGS, KAGS, and JAGS are shown in Figure 1.
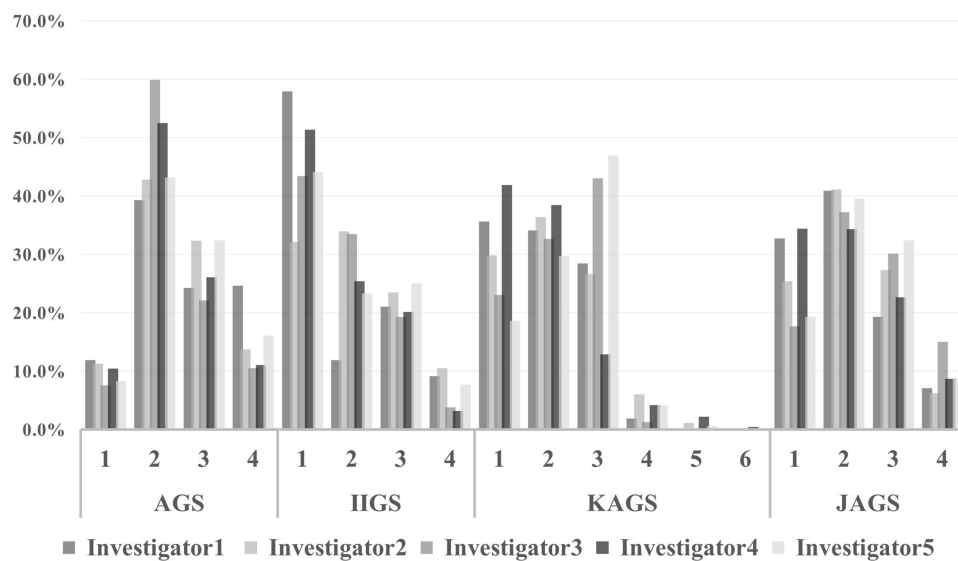

Figure 1 Frequencies of scores assessed by 5 independent investigators using AGS, IIGS, KAGS and JAGS.

Table 2 Correlations Between Different Tools

Method	Pearson (*r*)	P
AGS and IIGS	0.790 (95% CI: 0.764–0.813)	0.000
AGS and KAGS	0.748 (95% CI: 0.717–0.775)	0.000
AGS and JAGS	0.759 (95% CI: 0.730–0.784)	0.000
IIGS and KAGS	0.898 (95% CI: 0.888–0.908)	0.000
IIGS and JAGS	0.894 (95% CI: 0.883–0.905)	0.000
KAGS and JAGS	0.941 (95% CI: 0.934–0.947)	0.000

AGS, IIGS, KAGS and JAGS Reliabilities and Correlations

These four tools had adequate internal consistency: AGS (Cronbach's alpha 0.851), IIGS (Cronbach's alpha 0.830), KAGS (Cronbach's alpha 0.919), and JAGS (Cronbach's alpha 0.931). Reliability amongst raters using four tools [AGS: ICC 0.847 (95% CI: 0.830–0.862), $P \leq 0.001$; IIGS: ICC 0.823, (95% CI: 0.803–0.842), $P \leq 0.001$; KAGS: ICC 0.907, (95% CI: 0.885–0.924), $P \leq 0.001$; JAGS: ICC 0.923, (95% CI: 0.907–0.935), $P \leq 0.001$] had great reliability.

As displayed in Table 2, there were strong correlations amongst AGS, IIGS, KAGS and JAGS ($P \leq 0.001$). The Pearson (*r*) between AGS and KAGS [*r*=0.748 (95% CI: 0.717–0.775); $P \leq 0.001$] was lower than that between AGS and JAGS [*r*=0.759 (95% CI: 0.730–0.784), $P \leq 0.001$], and lower than that between AGS and IIGS [*r*=0.790 (95% CI: 0.764–0.813); $P \leq 0.001$]. IIGS had the best correlation with KAGS [*r*=0.898 (95% CI: 0.888–0.908); $P \leq 0.001$], followed by JAGS [*r*=0.894 (95% CI: 0.883–0.905); $P \leq 0.001$] and AGS [*r*=0.790 (95% CI: 0.764–0.813), $p \leq 0.001$]. Among all the pairwise comparisons, KAGS had the strongest correlation with JAGS [*r*=0.941 (95% CI: 0.934–0.947), $P \leq 0.001$]. Additionally, Figure 2 demonstrates the strong correlation among the four acne grading systems.

Investigator1 Using AGS and IIGS 1 Year Ago and Later

According to Table 3, when investigator 1 evaluated the participants 1 year ago using AGS, the majority of them were given grades 2–4 (32.0% for grades 2 and 4, 24.2% for grade 3 and 36.6% for grade 4). When investigator 1 reevaluated
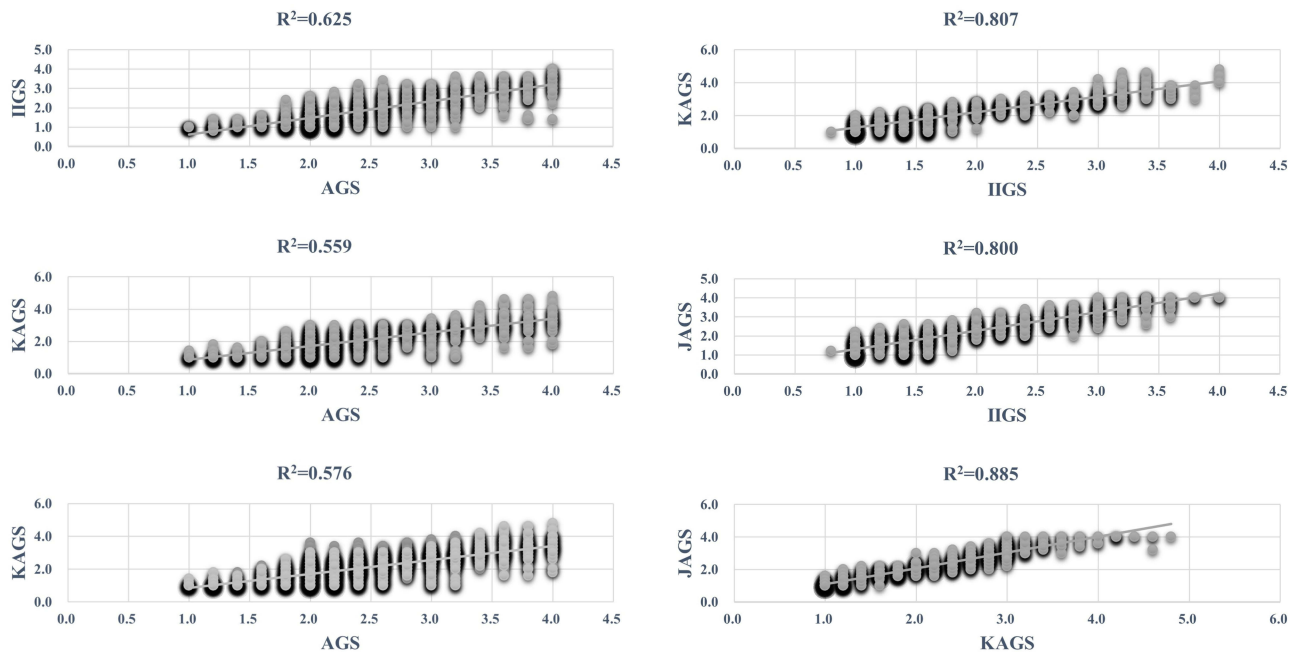

Figure 2 Correlation analysis among AGS, IIGS, KAGS and JAGS.
Notes: R^2 between AGS and IIGS was 0.625; R^2 between AGS and KAGS was 0.559; R^2 between AGS and JAGS was 0.576; R^2 between IIGS and IGA was 0.807; R^2 between IIGS and KAGS was 0.800; R^2 between KAGS and JAGS was 0.885.

Table 3 Frequencies of Scores Assessed by AGS and IIGS

Methods	0(%)	1(%)	2(%)	3(%)	4(%)	Pearson (*r*)	P
AGS1	0.1	7.2	32.0	24.2	36.6	0.747(95% CI: 0.704–0.783)	0.000
AGS2	0	11.9	39.3	24.2	24.6		
IIGS1	0.1	53.7	6.8	28.2	11.2	0.722 (95% CI: 0.684–0.758)	0.000
IIGS2	0	57.9	11.9	21.0	9.1		

Notes: AGS1 (1 year ago using GAS of investigator 1); AGS2 (1 year later using GAS of investigator 1); IIGS1 (1 year ago using IIGS of investigator 1); IIGS2 (1 year later using IIGS of investigator 1).

them 1 year later using AGS, the majority of the subjects were still determined to be in grades 2–4 (39.3% in grade 2, 24.2% in grade 3, 24.6% in grade 4). Using IIGS, Investigator 1 assessed participants before and after 1 year, and found that 53.7% and 57.9% of them were in grade 1, respectively. Figure 3 displayed the frequencies of investigator 1 evaluated the score using AGS and IIGS.

Participants were evaluated by investigator 1 using AGS (Cronbach's alpha 0.855) and IIGS (Cronbach's alpha 0.837) 1 year ago and later with adequate internal consistency. For reliability of intra-rater, the ICC of AGS of investigator 1 one year ago and later was 0.833 (95% CI: 0.748–0.832; p≤0.001), and the IIGS was 0.832 (95% CI: 0.804–0.855; P≤0.001). According to Table 3, there was a good correlation between investigator 1 using AGS and IIGS 1 year ago and later (P≤0.001). The Pearson (*r*) between AGS of investigator 1 one year ago and later was 0.747 (95% CI: 0.704–0.783; P≤0.001), and IIGS was 0.722 (95% CI: 0.684–0.758; P≤0.001). Additionally, there was a good correlation between AGS and IIGS of investigator 1 one year ago and later, as shown in Figure 4.

Discussions

There was not a single AV assessment tool available worldwide. GAGS was the assessment tool that was most frequently applied in different continents including Asia, Africa, Europe, and America out of all these acne grading systems.[11,12,21–24] GAGS scored the severity after evaluating the patient's face, chest, and back.[20] In this study, VISIA photos of the participants' faces were collected, excluding the chest and back, hence GAGS was not applied. IGA and CEA were primarily recommended in the United States, European countries, and some African countries.[25] Another study by our team showed that these two tools had a good correlation with AGS and IIGS, suggesting that AGS and IIGS could be recommended for application in the America, Europe and Africa.[21] This study was to compare AGS and IIGS with Japanese and Korean acne grading systems to determine whether these two tools were applicable to Asian populations
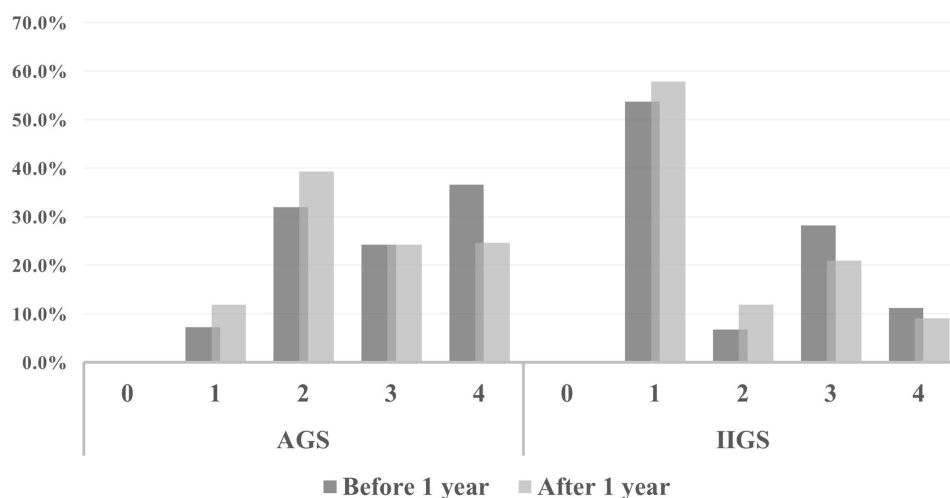

Figure 3 Frequencies of scores assessed by investigator 1 using AGS, IIGS, KAGS and JAGS 1 year ago and later.
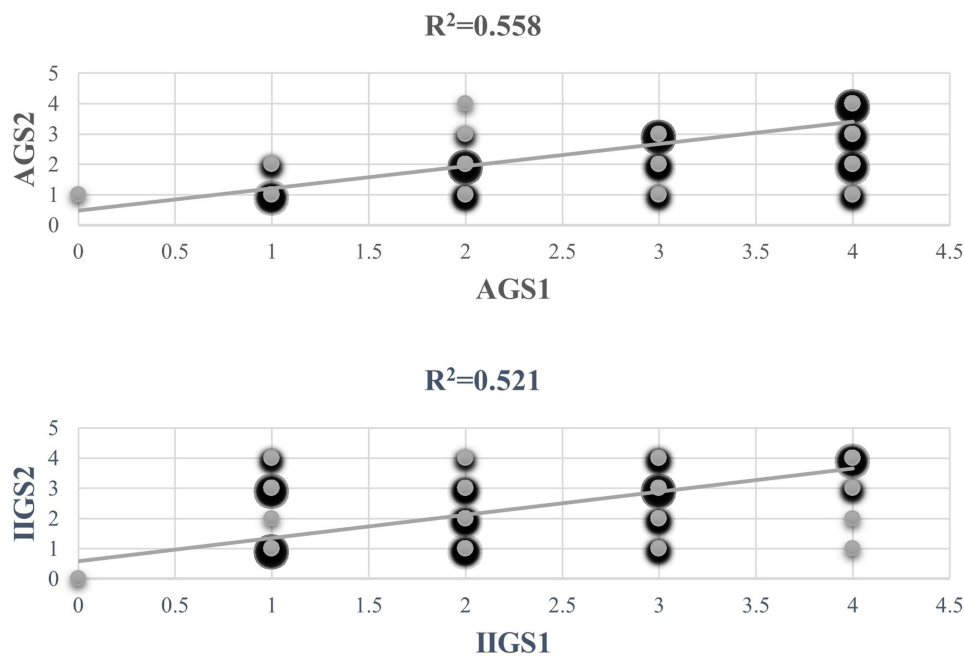
R²=0.558

R²=0.521

Figure 4 Correlation among investigator 1 using AGS, IIGS 1 year ago and latter.
Notes: AGS1 (1 year ago using GAS of investigator 1); AGS2 (1 year later using GAS of investigator 1); IIGS1 (1 year ago using IIGS of investigator 1); IIGS2 (1 year later using IIGS of investigator 1).

outside of China. Moreover, KAGS and JAGS were selected since Korea and Japan are both Asian nations and had ethnic similarities with China.

In China, physicians from prestigious hospitals might employ assessment tools to evaluate the severity of common disorders when they had sufficient time. However, if the evaluation process was overly complicated and time-consuming, even physicians from prestigious hospitals might abandon because they had too many patients to deal with each day. Even worse were physicians from community hospitals. It was critical to apply straightforward and quick assessment tools since, as we all know, guidelines stated that therapy should be based on the severity of the disorder as determined by evaluation tools. According to the study, AGS and IIGS were trustworthy and had a strong association with KAGS and JAGS, which agreed with those of the prior study.[21] The AV severity in China could be assessed using IIGS and AGS, especially the easy-to-use assessment tool AGS.

It is universally acknowledged that a very high correlation is indicated by an *r*-value between 0.9 and 1, meanwhile a high correlation is indicated by an *r*-value between 0.7 and 0.9. In this study, there were substantial positive associations between pairwise comparisons of KAGS, JAGS, IIGS and IGA. This suggested that AV patients could be evaluated using AGS and IIGS in clinical and research among AV patients from Japan and Korea. Low AGS-to-other tools Pearson correlation coefficients may be due to the following factors: (1) Of the four tools, AGS is the quickest and most straightforward evaluation tool. It only measures the type of lesion, and the value change restricts the ability to identify lesion change; (2) Other tools are complex and time-consuming, depending on the type and quantity/semi quantity of lesions, and the disease is described in more detail and appears to be more suitable for investigation. Although AGS had a weaker positive correlation with IIGS, KAGS, and JAGS in this study, AGS was the most simple and rapid evaluation tool of these 4 tools and the one that should be used first in clinical practice in China.

It was reported that counting AV lesions had excellent reliability when accomplished by trained investigators.[26,27] After only a short period of training, Japanese dermatologists and Korean dermatologists were able to grade the severity of AV from photos with a consistency of about 90% and 80%, respectively.[24,28] To increase the reliability of acne lesion counts and types in medical practice and project investigation, investigators and dermatologists should be trained before conducting the study. Five investigators were received a combined of 24 hours training prior to assessment in this study. AGS, IIGS, KAGS, and JAGS by 5 investigators demonstrated excellent agreement on the AV severity in terms of

internal reliability of raters. Additionally, investigator 1 demonstrated outstanding consistency in assessing the severity of AV using IIGS and AGS 1 year ago and later.

This study has some limitations, including (1) There were 5 investigators participated in this study. To make the study more scientific in the future, more investigators should be involved. (2) Investigator 1 was the only investigator to participant in both this study and another study conducted last year; investigators 2–5 recruited other dermatologists for this study. If investigators 2–5 had also participated in this study, the results would be more comparable. (3) Post-inflammatory pigmentation and acne scarring, which have a negative impact on AV patients, were not taken into account by these four grading systems. (4) New acne grading systems were not investigated in this study. In the future, studies should be conducted to determine whether the new acne grading systems are consistent with those recommended by each country.

Conclusion

IIGS and AGS were trustworthy in determining the severity of AV and had a substantial connection with KAGS and JAGS. It was demonstrated again that IIGS and AGS should be suggested for application in medical practice and project investigation.

Disclosure

The authors disclose no conflicts of interest in this work.

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