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VALIDATION OF THE SIMPLIFIED FERRIMAN-GALLWEY SCORE: A SENSITIVE TOOL FOR PCOS DIAGNOSIS IN RESOURCE-LIMITED SETTINGS

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Abstract:
Introduction: Females diagnosed with polycystic ovary syndrome (PCOS) face an 11-fold higher likelihood of developing metabolic syndrome and glucose intolerance in comparison to their healthy counterparts. Nevertheless, timely identification and treatment of PCOS can mitigate the risk of long-term metabolic irregularities. Consequently, this research aimed to assess the diagnostic efficacy of the simplified Ferriman-Gallwey (sFG) index in identifying PCOS within a resource-constrained environment.
Material and Methods: We conducted a prospective observational study among 541 women of reproductive age who visited the Gynecology OPD in Govt Hospital Maharashtra for a period of 8 months (February 2024 to September 2024). The data was collected in the form of pre-validated questionnaire and analysed using SPSS software.
Results: The mean (SD) age of the study participants was 31.7 (5.5) years. The mean (SD) and median sFG score was 5.2 (2.0) and 5.0 respectively. The sensitivity and specificity of the sFG Index to detect PCOS were 93.2% and 65.9%, respectively, with an AUC of 0.893 (95%CI: 0.860-921; p≤0.05).
Conclusion: We conclude that the sFG score may serve as an efficacious screening tool for PCOS in resource-limited settings due to its high sensitivity. This instrument can be utilised by medical officers, gynaecologists, and dermatologists for initial screening of PCOS cases to facilitate further investigation.

Key words: Hisrutism, PCOS, sFG, Ferriman-Gallwey score

Introduction:

Hirsutism, the development of terminal hair growth in women with a male pattern, constitutes approximately 5-10% of women aged 18–45 years in India, with varying prevalence reported across different regions and studies (1). Androgen-sensitive anatomical sites exhibiting the male sexual pattern encompass the face, chest, breast areola, linea alba, lower back, buttocks, inner thighs, and

external genitalia. These regions demonstrate characteristic responses to androgenic hormones, contributing to the manifestation of male-specific secondary sexual characteristics. Polycystic ovarian syndrome (PCOS), androgen-secreting tumours, and non-classic adrenal hyperplasia are among the androgen excess disorders that are frequently linked to it (2). In women with PCOS, hirsutism is present in an estimated 65-75% of cases, contrasting sharply with its 5-10% occurrence in the general female population. The manifestation of hirsutism ranges in severity, influenced by both the level of androgen excess and individual differences in the pilosebaceous unit's androgen sensitivity (3,4). The mFG scoring system uses a visual scoring system with a range of 0–4, where 0 denotes no terminal hair growth and 4 denotes terminal hair growth in the full-male pattern. However, this system has certain drawbacks. First, it entails a thorough medical examination that evaluates and scores all nine body parts, which many patients may find intrusive and inconvenient when conducting epidemiological research. Simplified Ferriman-Gallwey images (sFG), a standardised method and the most popular scoring system, entails the subjective tabulation of terminal hair growth in different body parts to assess hirsutism (5).

PCOS, or Polycystic Ovary Syndrome, is a multifaceted, persistent endocrine disorder with varied manifestations. This condition often presents with challenges in reproduction, excessive body hair, dermatological issues, increased body mass, and aberrations in menstrual patterns (6). The pooled prevalence of PCOS among Indian women is 11.33%, while the global prevalence varies widely, estimated between 5% and 20% depending on the population and diagnostic criteria used (7). Three sets of criteria, the Rotterdam criteria (2003) (8), Androgen Excess Society criteria (2006), and National Institutes of Health criteria (1992), have been developed for the identification of PCOS. All three subgroups encompass polycystic ovarian morphology on transvaginal ultrasound, clinical and/or biochemical hyperandrogenism, chronic oligo/anovulation, or various combinations of these conditions (9).

The diagnosis of PCOS necessitates the presence of at least two of the following criteria: polycystic ovarian morphology (characterised by ≥20 follicles per ovary and/or an ovarian volume ≥10 mL in either ovary, ideally evaluated through endovaginal ultrasonography), hyperandrogenism (manifesting biochemically or clinically), and ovulatory dysfunction (presenting as oligo- or amenorrhoea).Other related or mimicking disorders should be excluded (10). Whilst the underlying cause of PCOS remains unclear, its diagnosis is based on reproductive system irregularities, excess androgen production, and chronic lack of ovulation, after ruling out primary disorders of the ovaries, adrenal glands, and pituitary gland. Females diagnosed with PCOS face an 11-fold higher likelihood of developing metabolic syndrome and impaired glucose tolerance compared to their healthy peers. Early identification and treatment of PCOS may help avert long-term metabolic complications.

The characteristics of patients with hirsutism and PCOS have only been assessed in a small number of studies, and the results have been inconsistent. A study by ICMR demonstrated that the majority of health-care providers (HCPs) lacked accurate knowledge regarding diagnostic criteria and investigations necessary for the diagnosis of PCOS (11). Additionally, the diagnostic methodology for a significant number of women afflicted with PCOS exhibits notable inefficiencies and inadequacies. Therefore, the objective of this study was to evaluate the accuracy of the simplified Ferriman-Gallwey index in the prediction of PCOS in a resource-limited setting.

Material and Methods:

We conducted a prospective observational study among 541 women of reproductive age who visited the Gynaecology OPD in Govt Hospital, Maharashtra, for a period of 8 months (February 2024 to September 2024). We included married women aged 18 to 50 years and excluded pregnant women, women using oral contraceptive pills, those with hypothyroidism, those with chronic medical and mental health conditions, and those who were unwilling to participate in the study. The procedure was explained to all study participants and informed consent was obtained.

The data were collected in the form of a pre-validated questionnaire with socio-demographic profile, marital status, anthropometry, and menstrual cycle characteristics. Furthermore, participants were

asked regarding their utilisation of hair removal methods, including depilation, epilation, or decolourisation of hair on areas other than their lower limbs or axillae. The subjects were evaluated for terminal hair growth in six of the nine body regions on the modified Ferriman-Gallwey (FG) scale that are most strongly associated with hirsutism: the upper lip, chin, chest, upper and lower abdomen, and thighs as shown in Fig. 1 (12). Data were collected through direct examination of six areas of hair growth that have demonstrated high sensitivity and can be utilised as screening tools for polycystic ovary syndrome (PCOS) in resource-limited settings. The simplified FG (sFG) score was utilised to define hirsutism, with a threshold of five or greater indicating its presence. Confirmation of PCOS was achieved through a combination of ultrasonographic (USG) examination and hormonal analysis, specifically assessing levels of follicle-stimulating hormone (FSH) and luteinising hormone (LH).

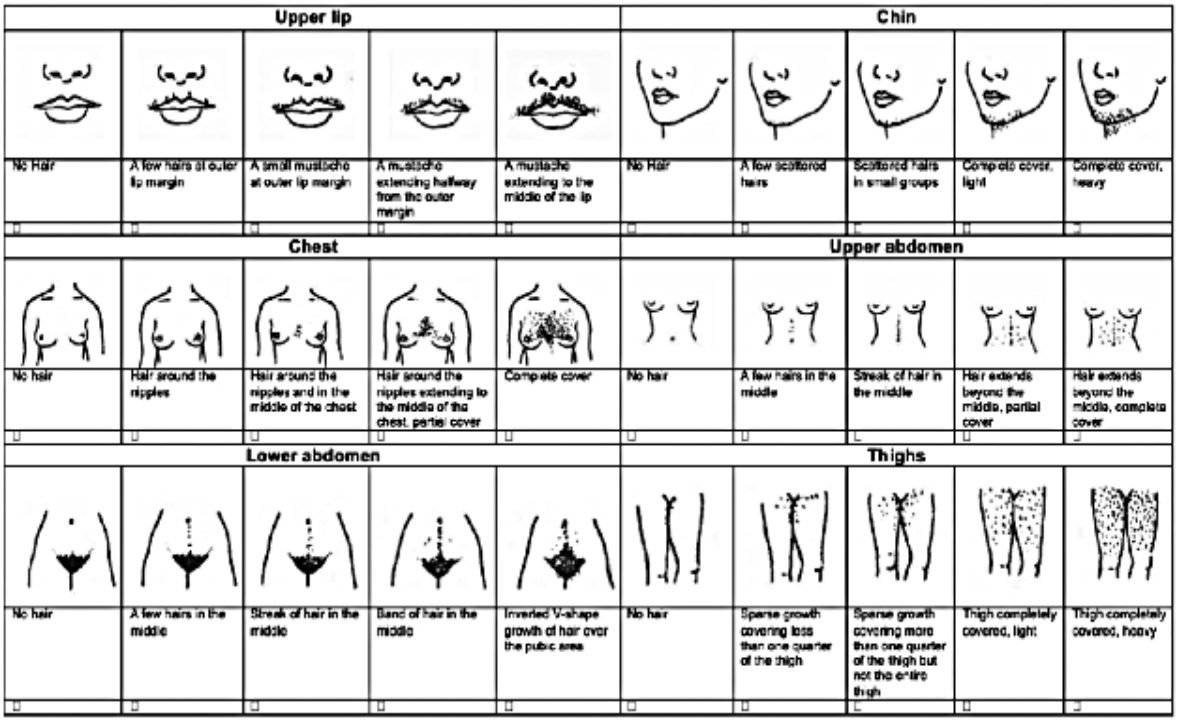

Figure 1. Simplified Ferriman-Gallwey images in Questionnaire.

Data were tabulated and analysed using Microsoft Excel and SPSS version 26. Descriptive data were summarised as frequency and continuous data as mean and standard deviation. Chi-square and Fisher exact tests were applied to determine the association between the general characteristics of participants and sFG score with PCOS. The ability of sFG to predict the diagnosis of PCOS was assessed using the AUROC (areas under the receiver operating characteristic) curve.

Results:

Socio-demographic profile

The mean (SD) and median age (range: 20-48 years) of the study participants were 31.7 (5.5) and 31 years, respectively. The years of marriage ranged from 1 to 25 years, with a median of 7 years. Most of the participants (492 (90.9%]) were educated up to higher secondary and not much difference between rural and urban distribution, as shown in Table 1. The participants belonged to various states throughout the country, and most of them were native to UP, Punjab, and Haryana, as shown in fig 2.

Table 1. Characteristics of study participants

Characteristics	N	%
Socio-demographic Profile		
Age Category		
20-29	203	37.5

30-39	287	53.0
40-49	51	9.4
Urban or Rural		
Rural	297	54.9
Urban	244	45.1
Highest Level of Education		
Higher Secondary	492	90.9
Graduate	49	9.1
Dietary preferences and BMI		
Dietary Preference		
Vegetarian	273	50.5
Non Vegetarian	210	38.8
Egg Vegetarian	58	10.7
BMI category (as per WHO classification)		
Underweight	27	5.0
Normal	287	53.0
Overweight	180	33.3
Obese Class I	39	7.2
Obese Class II	8	1.5
Menstrual history and RBS		
Menstrual cycle		
Regular	382	70.6
Irregular	159	29.4
RBS levels		
<140	534	98.7
140-200	4	0.7
>200	3	0.6

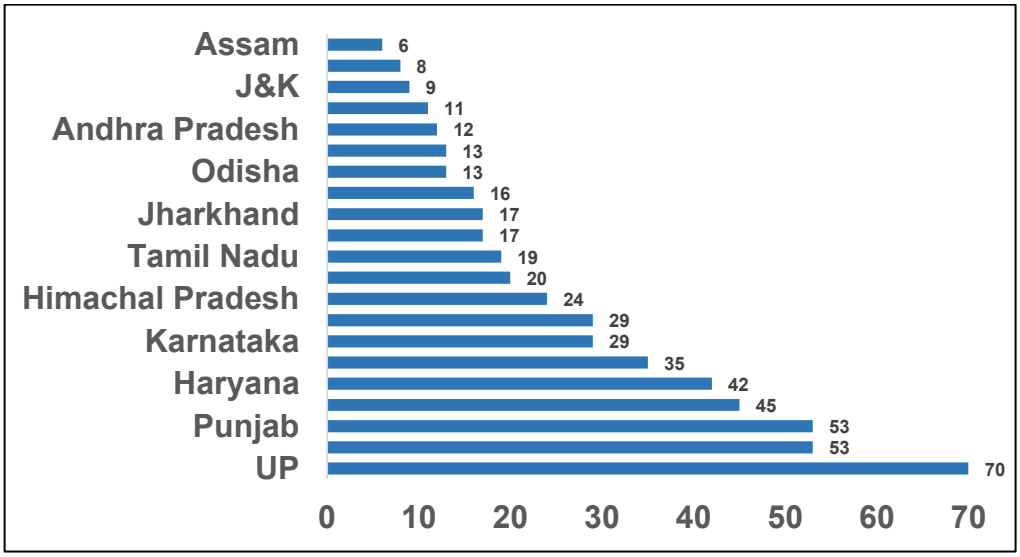

Figure 2. Distribution of cases as per native state

Dietary preferences and BMI

Approximately half (273, 50.5%) of the participants were vegetarians. The mean (SD) BMI was 24.4 (4.1) Kg/m^2 and one third of participants (180, 33.3%) were overweight, almost 1 in 100 participants was obese and a few were underweight (27, 5%) as shown in table 1. There was a significant difference in BMI between PCOS and non-PCOS cases ($p \leq 0.05$), as shown in Table 2.

Table 2. Association between general characteristics with PCOS

Variable	PCOS		p value
	Yes	No	
Age Category			
20-29	74 (41.8)	129 (35.4)	0.354
30-39	88 (49.7)	199 (54.7)	
40-49	15 (8.5)	36 (9.9)	
Rural vs Urban			
Rural	100 (56.5)	197 (54.1)	0.645
Urban	77 (43.5)	167 (45.9)	
Menstrual cycles			
Regular	101 (57.1)	281 (77.2)	0.000*
Irregular	76 (42.9)	83 (22.8)	
BMI			
Underweight	13 (7.3)	14 (3.8)	0.050*
Normal	80 (45.2)	207 (56.9)	
Overweight	66 (37.3)	114 (31.3)	
Obese	18 (10.2)	29 (8.0)	
RBS levels			
<140	177 (100.0)	357 (98.1)	0.080
140-200	0 (0)	4 (1.1)	
>200	0 (0)	3 (0.8)	

Menstrual cycles and RBS

The median duration of menstruation was 5 days (range: 0-11 days), and almost one-third of the women (159, 29.4%) had irregular menstrual cycles. Mean (SD) RBS levels were 100.3 (19.2) mg/dl and a few (7, 1.3) women had elevated RBS levels, as shown in Table 1. There were more participants with irregular menstrual cycles in the PCOS group than non PCOS and the difference was statistically significant (P <0.001).

Association between hair growth of sFG scoring areas and PCOS

All the six areas of hair growth were shown significant signs of hair growth in the cases of PCOS as per sFG index score and also found statistically significant (p<0.001). The mean (SD) and median sFG score was 5.2 (2.0) and 5.0 respectively. We found a 51% (n=276) prevalence of hirsutism in our study. Of these, 165 (59.8%) were diagnosed as PCOS that means with 177 PCOS cases 165 (93.2%) had hirsutism, as shown in Table 3. The sensitivity and specificity of the sFG Index to detect PCOS were 93.2% and 65.9%, respectively, with an AUC of 0.893 (95%CI: 0.860-921; p≤0.05), as depicted in Fig 3 and Table 4.

Table 3. Simplified Ferriman-Gallwey (sFG) scoring areas and its association with PCOS (p≤0.001)

Characteristics of hair growth	PCOS		
	Yes	No	Total
Upper Lip			
No Hair	0 (0)	33 (9.1)	33 (6.1)
Few Outer Lip	80 (45.2)	331 (90.9)	411 (76.0)
Small Moustache Outer Lip	97 (54.8)	0 (0)	97 (17.9)
Chin			
No Hair	18 (10.2)	181 (49.7)	199 (36.8)

Few Hair	116 (65.5)	183 (50.3)	299 (55.3)
Scattered Hair Groups	43 (24.3)	0 (0)	43 (7.9)
Chest			
None	147 (83.1)	364 (100.0)	511 (94.5)
Hair Around Nipple	30 (16.9)	0 (0)	30 (5.5)
Upper Abdomen			
No Hair	4 (2.3)	44 (12.1)	48 (8.9)
Few Hairs in Middle	85 (48.0)	301 (82.7)	386 (71.3)
Streak of Hair in Middle	82 (46.3)	19 (5.2)	101 (18.7)
Hair Extends Beyond Middle	6 (3.4)	0 (0)	6 (1.1)
Lower Abdomen			
No Hair	2 (1.1)	0 (0)	2 (0.4)
Few Hairs in Middle	92 (52.0)	307 (84.3)	399 (73.8)
Streak Hair in Middle	79 (44.6)	57 (15.7)	136 (25.1)
Band Hair in Middle	4 (2.3)	0 (0)	4 (0.7)
Thighs			
No Hair	2 (1.1)	89 (24.5)	91 (16.8)
Sparse Growth <1/4th of Thigh	137 (77.4)	270 (74.2)	407 (75.3)
Sparse Growth >1/4th of Thigh	38 (21.5)	5 (1.4)	43 (7.9)
sFG			
Score ≥ 5	165 (93.2)	111 (30.5)	276 (51.0)
Score < 5	12 (6.8)	253 (69.5)	265 (49.0)

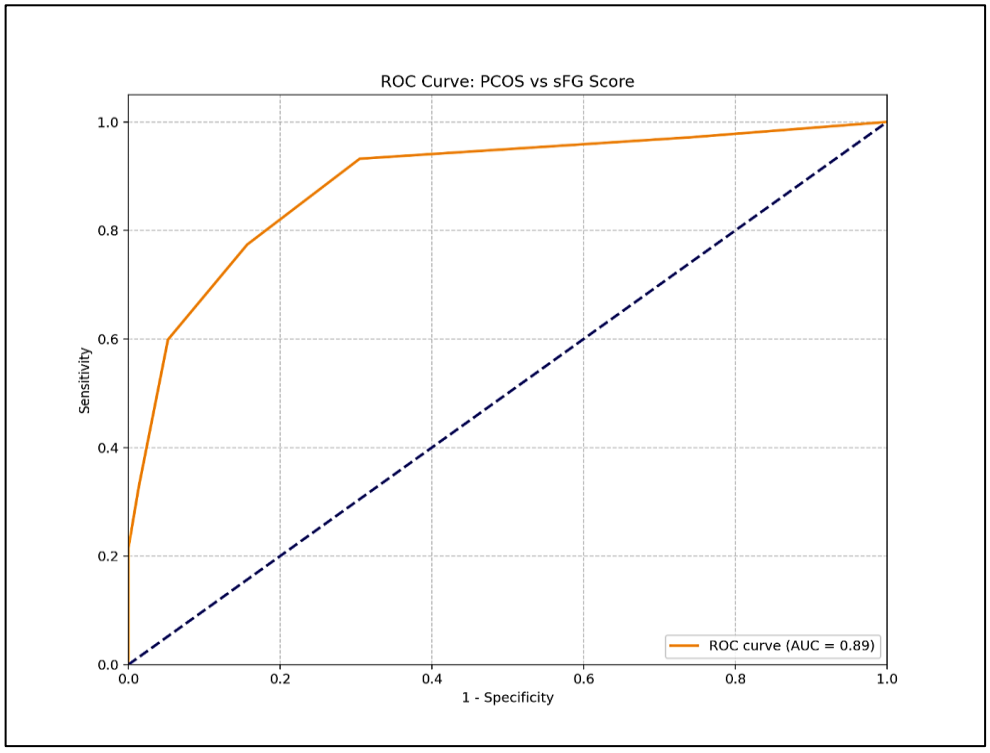

Figure 3. Receiver Operating Characteristic (ROC) Curve of sFG score

Table 4. Characteristics of ROC Curve (sFG score vs PCOS)

Variable	Cut Off	AUC	95 CI	Sensitivity (%)	Specificity (%)	Accuracy (%)	p value
sFG	5	0.893	0.860-0.921	93.22	69.51	77.26	<0.001

Discussion:

Polycystic ovary syndrome (PCOS) represents the foremost endocrine disorder, causing anovulation amongst females within their reproductive years. The clinical manifestations of PCOS encompass symptoms of androgen excess (hirsutism), irregular menstruation (amenorrhoea or oligomenorrhoea), infertility, elevated insulin resistance, acne, and alopecia, as well as varying degrees of obesity. Among these characteristics, only 5–10% of women present with the typical symptoms of PCOS. Hirsutism is a common condition in women with PCOS. With a 50–80% prevalence, it is the most frequent clinical manifestation of androgen excess syndrome and is characterised by excessive growth of androgen-dependent hair in women. In women of reproductive age, hirsutism is a clinical and undesirable condition associated with androgen excess.

A cross-sectional study conducted by Panidis et al. among 1297 patients with PCOS demonstrated that hirsutism was present in 60.1% of the study population (13). In the United States and Europe, the prevalence of hirsutism in PCOS patients varies by ethnicity and ranges from 40 to 92%; however, it is lower in Japanese and Asian women and higher in populations with darker skin pigmentation (14). Hirsutism was present in 91% of the patients in a study conducted in India (15). Similarly, our study showed a 93.2% prevalence of hirsutism in patients with PCOS.

A pilot cross-sectional investigation in India, aimed at assessing urban-rural disparities in polycystic ovarian syndrome prevalence among adolescent females, indicated a higher incidence of PCOS in urban areas compared to rural regions. In contrast, our research yielded no such urban-rural distinction. It is important to note that our study focused on adult subjects, whereas the aforementioned research examined adolescents (10).

Pathania, V et al., studied 100 women of reproductive age group showed that the mean age of the presentation was 22.36 ± 04.68 years; the majority of 55% of cases were in the third decade, which was in concordance with our study findings that more than half of study participants were belongs to age group 30-39 years and whereas our study shown the mean age of study participants was 31.7 (5.5) years (15). Our study showed that the mean BMI of participants was 24.4 (4.1) Kg/m^2 similar to a study in India where the mean BMI for PCOS patients was 25.48±3.82 kg/ m^2 and 23.67±3.8 kg/m^2 in hirsutism (15).

The mean sFG score in our study was 5.2 ± 2.0 with 6 areas of hirsutism and which was about half to 10.67 ± 2.45 in a study by Pathania V et al; 10.23 ± 2.46 in a study by Sharma *et al*. and 10.5 ± 4.1 by Azziz *et al*. according to mFG score where they examined 9 areas of hirsutism. A cross-sectional study by Panidis et al. among 1297 patients with PCOS showed that the mean (SD) Ferriman–Gallwey score was 8.2 (4.6) and hirsutism was present in 60.1% of the study population (13). Another study in Mexico showed that out of 873 patients, 75.5% had hirsutism clinically and 82% had polycystic ovary syndrome (PCOS) and shown hirsutism in PCOS was 72.2% (16) where in our study shown higher than those studies.
Bronwyn S. Bedrick et al., shown that self-administered sFG score with cut off ≥3 has sensitivity and specificity of 76% and 70% respectively to diagnose PCOS. The research conducted by Pedersen et al. demonstrated that a constellation of symptoms, including acne, hirsutism, obesity, and menstrual irregularities, served as a robust predictor for PCOS diagnosis, yielding a sensitivity of 77% and a specificity of 94%. Whereas, in our study the sensitivity and specificity was 93.2% and 69.5% respectively with sFG score cut off ≥5 which can be used as a good screening tool for PCOS (5,12).

Our findings indicate that the detection of hirsutism via a self-administered pictorial questionnaire exhibits considerable sensitivity and fair specificity when employed as a screening method for PCOS identification. Consequently, this instrument may be utilised by medical officers, gynaecologists, and dermatologists in resource-limited settings to screen for PCOS and facilitate further diagnostic procedures.

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