Factor Analysis of the Beer Sheva Psoriasis Severity Score (BPSS)

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Abstract

Background: The Beer Sheva Psoriasis Severity Score is a novel instrument for the assessment of psoriasis severity, designed for use in routine clinical conditions.

Objective To identify the main factors of the BPSS.

Methods: The sample used to study the BPSS comprised 70 patients with psoriasis vulgaris treated by climatotherapy at the Dead Sea. Psoriasis severity was assessed using BPSS and PASI (Psoriasis Area and Severity Index). Factor analysis was used to identify the main factors of BPSS. Internal consistency analysis was performed. Correlation matrices were generated to compare BPSS factors.

Results: Factor analysis demonstrated that BPSS included six factors that explained 74.0% of the variance as follows: patient assessment 26.0%; physician assessment 13.2%; palms and soles involvement 11.9%; genitals, nails, and pruritus 9.0%; face involvement 7.3%; and scalp involvement 6.6%. Total scale Cronbach's alpha was 0.76; alpha for the factors ranged between 0.39 and 0.81.

Conclusions: The major factors of BPSS were identified. BPSS may be used as a comprehensive tool for measuring psoriasis severity.

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The Psoriasis Area and Severity Index is widely used and serves as a surrogate for a gold standard for the assessment of psoriasis severity [1]. However, the PASI has several drawbacks that prevent it from becoming a practical clinical instrument for routine clinical use. It does not consider involvement of the face, palms and soles, or the genital area. Even mild involvement in these locations may greatly affect the patient's suffering but is underestimated in the total PASI score. Moreover, PASI does not include quality of life parameters [1–5]. The PASI score is too long to perform and therefore impractical for routine clinical use. The need for a new instrument to assess psoriasis severity for both research and routine clinical use is widely recognized in the dermatological world [6;7].

It has been suggested that technical instruments can be used to assess psoriasis severity by measuring the clinical signs of the disease – namely, erythema, induration, and desquamation. For example, erythema was measured by spectroradiometer, chromameter, and laser Doppler velocimeter [8–10]. Although

it is tempting to use an "objective" measure to assess psoriasis severity, the above-cited technical instruments fundamentally fail to assess the overall impact of psoriasis and, in particular, its profound psychological effect. In addition, technical instruments are complicated and costly to use..

Several instruments for assessing psoriasis severity have been described in recent years, such as the Physician's Global Assessment, Dermatology Life Quality Index, Psoriasis Disability Index, Psoriasis Life Stress Inventory, and the Salford Psoriasis Index [11–16]. However, unlike PASI, none of these instruments has achieved broad approval.

The Beer Sheva Psoriasis Severity Score is a novel and simplified instrument for the assessment of psoriasis. It includes items that are recorded by the physician (total severity and distribution of the disease) and items recorded by the patient (total, physical and psychological severity, pruritus, and distribution of the disease). In a previous work, we demonstrated the criterion validity and responsiveness of BPSS in reflecting clinical improvement during climatotherapy at the Dead Sea [17]. In the current study, we investigated the factors that comprise BPSS using factor analysis and internal consistency analysis (Cronbach's alpha).

Patients and Methods

The study was conducted in the southern district of Clalit Health Services, the largest managed care organization in Israel. In that region, Clalit Health Services serves approximately 470,000 members, and its dermatology service includes 17 active dermatologists working in 23 clinics from Ashkelon in the north to Sapir in the south, accounting for approximately 110,000 patient-physician encounters annually.

Beer Sheva Psoriasis Severity Score

The BPSS is a novel tool for the ambulatory assessment of patients with psoriasis [Table 1]. It has several advantages over the traditional PASI, namely, it is simple and includes items of disease distribution that are lacking in PASI (face, palms and soles, genital area, nails), as well as items of quality of life assessment, global severity indices (assessed by both patients and physicians), and assessment of pruritus.

BPSS includes eight items that are recorded by the physician (total severity of the disease, and seven items relating to the physical distribution of the disease) and eight items recorded by the patient (total severity, physical and psychological sever-

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PASI = Psoriasis Area and Severity Index
BPSS = Beer Sheva Psoriasis Severity Score

Table 1. Beer Sheva Psoriasis Severity Score (BPSS)

Physician Assessment

Assess the severity of the patient's psoriasis during the last month

	0	1	2	3	4	5	6	7	8	9	10
	No disease	Very mild									Very severe
Total severity											

	0	1	2	3
Area	No involvement	Mild involvement	Moderate involvement	Severe involvement
Scalp involvement				
Face and neck involvement				
Upper limbs involvement				
Palms involvement				
Trunk involvement				
Lower limbs involvement				
Soles involvement				

Patient Assessment

Assess the severity of your psoriasis during the last month

	0	1	2	3	4	5	6	7	8	9	10
	No disease	Very mild									Very severe
Total severity											

	0	1	2	3	4	5	6	7	8	9	10
	No disease	Very mild									Very severe
Assess the physical severity of your disease											
Assess the psychological severity of your disease											
Assess the severity of pruritus											
Assess the severity of involvement of the face											
Assess the severity of involvement of the nails											
Assess the severity of involvement of the palms and soles											
Assess the severity of involvement of the genitals											

ity, pruritus, and assessment of involvement in the face, nails, palms and soles, and genital regions). All variables in BPSS are assessed using linear 4–10 point visual analogue scales. All scores are summed directly, except for the seven items of disease distribution assessed by the physician (which have four-point scales, and are multiplied by 2.5). BPSS ranges from 0 to 160, with the high scores representing severe disease [17].

Psoriasis Area and Severity Index

Clinical assessment of psoriasis severity was done at baseline and at the end of the treatment period using PASI [1]. In the PASI scoring system the body regions assessed are: head (h), upper extremities (u), trunk (t), and lower extremities (l). The area of involvement for each of the body regions is assigned a numerical value (A) of 0–6 corresponding to 0–100% involvement: 0 = no involvement, 1 < 10%, 2 = 10 < 30%, 3 = 30 < 50%, 4 = 50 < 70%, 5 = 70 < 90%, and 6 = 90–100%. For each region,

erythema (E), induration (I), and desquamation (D) are rated using a five-point scale (0 = no involvement, 1 = slight, 2 = moderate, 3 = severe, 4 = very severe). PASI is then calculated from the following formula:

$$PASI = 0.1Ah(Eh + Ih + Dh) + 0.2Au(Eu + Iu + Du) + 0.3At(Et + It + Dt) + 0.4Al(El + Il + Dl)$$

PASI ranges from 0 to 72, with high scores representing severe disease.

Patients

The study group comprised Israeli patients with chronic, stable, plaque-type psoriasis vulgaris who received climatotherapy at the Dead Sea. Patients who were using photosensitizing medications or had a preexisting photosensitive disease were excluded. All patients were advised to stop any topical treatment (except

emollients) and ingestion of systemic anti-psoriatic drugs, 2 and 4 weeks, respectively, before climatotherapy.

Climatotherapy at the Dead Sea

Treatment was carried out in the Ein Bokek area on the shores of the Dead Sea. The treatment protocol for psoriasis at the Dead Sea included sunlight exposure, bathing in Dead Sea water, and the use of emollients. Exposure to the sun was gradual, for a duration that depended on skin type, season of the year, and time of day. Patients used emollients such as vaseline, baby oils, and moisturizing creams freely before and after treatment. Severity of psoriasis was assessed in all patients before climatotherapy at the Dead Sea using both the BPSS and the PASI.

Statistical analysis

Results of categorical variables are presented as percentages, continuous variables are presented as means ± SD. P values ≤ 0.05 were considered statistically significant.

Factor analysis

Factor analysis attempts to identify underlying variables that explain the pattern of correlations within a set of observed variables. It is often used in data

Table 2. Range, means, and standard deviations of PASI, BPSS, and items of BPSS

	Min.	Max.	Mean	SD	Proportion of patients with a score exceeding the cutoff level**
PASI	3.0	56.2	16.6	11.0	
BPSS	37.0	117.5	72.8	19.6	
BPSS – Physician evaluation					
Assess the total severity	2.0	10.0	6.3	2.2	89.4%
Assess the scalp involvement *	0.0	3.0	1.6	1.0	54.3%
Assess the face involvement *	0.0	3.0	0.9	0.8	17.1%
Assess the upper limbs involvement *	0.0	3.0	2.0	0.8	78.6%
Assess the palms involvement *	0.0	3.0	0.4	0.8	11.4%
Assess the trunk involvement *	0.0	3.0	2.2	0.9	75.7%
Assess the lower limb involvement *	0.0	3.0	2.3	0.8	78.6%
Assess the soles involvement *	0.0	3.0	0.5	1.0	15.7%
BPSS – Patient evaluation					
Assess the physical severity of your disease	2.0	10.0	6.8	2.0	95.5%
Assess the psychological severity of your disease	1.0	10.0	7.7	2.3	93.8%
Assess the severity of pruritus	0.0	10.0	6.7	2.3	85.7%
Assess the severity of involvement of the face	0.0	10.0	3.8	3.1	44.3%
Assess the severity of involvement of the nails	0.0	10.0	4.2	3.5	50.0%
Assess the severity of involvement of the palms and soles	0.0	10.0	3.4	3.4	42.9%
Assess the severity of involvement of the genitals	0.0	10.0	3.6	3.5	42.9%
Assess the total severity of your disease	0.0	10.0	6.9	1.9	97.1%

All items have 10 scale marks, except for items that are marked with *, which have 4 scale marks.

** The cutoff level was defined as 2 in items with 4 scale marks and 4 in items with 10 scale marks.

Tabel 3. Results of principal component analysis with varimax rotation of the 16-item Beer Sheva Psoriasis Severity Score

	Factor loadings					
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Variable wording	Patient assessment	Physician assessment	Palms and soles involvement	Genitals, nails, and pruritus	Face involvement	Scalp involvement
Assess the total severity of your disease (patient)	.906					
Assess the physical severity of your disease (patient)	.847					
Assess the psychological severity of your disease (patient)	.736					
Assess the lower limbs involvement (physician)		.822				
Assess the upper limbs involvement (physician)		.798				
Assess the trunk involvement (physician)		.727				
Assess the total severity (physician)		.510				
Assess the soles involvement (physician)			.822			
Assess the severity of involvement of the palms and soles (patient)			.798			
Assess the palms involvement (physician)			.662			
Assess the severity of involvement of the genitals (patient)				.798		
Assess the severity of involvement of the nails (patient)				.766		
Assess the severity of pruritus (patient)				.468		
Assess the face involvement (physician)					.859	
Assess the severity of involvement of the face (patient)					.805	
Assess the scalp involvement (physician)						.901
Percent of explained variance*	26.0	13.2	11.9	9.0	7.3	6.6
Alpha for each factor**	0.81	0.67	0.46	0.62	0.39	–

* Total scale explained variance 74.0%

**Total scale alpha 0.76

Table 4. Correlation matrix comparing BPSS, PASI, and BPSS factors*

		BPSS	PASI	Patient assessment	Physician assessment	Palms and soles involvement	Genitals, nails, and pruritus	Face involvement	Scalp involvement
BPSS	r	1.00	0.61	0.50	0.40	0.30	0.48	0.42	0.18
	Pvalue	.	<0.001	<0.001	<0.001	0.02	<0.001	<0.001	0.17
PASI	r	0.61	1.00	0.42	0.63	0.07	0.15	0.03	0.18
	Pvalue	<0.001	.	<0.001	<0.001	0.60	0.27	0.85	0.18
Patient assessment	r	0.50	0.42	1.00	0.06	-0.05	0.01	0.03	-0.01
	Pvalue	<0.001	<0.001	.	0.67	0.70	0.96	0.84	0.93
Physician assessment	r	0.40	0.63	0.06	1.00	-0.01	-0.02	0.02	0.01
	Pvalue	<0.001	<0.001	0.67	.	0.92	0.87	0.85	0.97
Palms and soles involvement	r	0.30	0.07	-0.05	-0.01	1.00	-0.03	0.01	-0.03
	Pvalue	0.02	0.60	0.70	0.92	.	0.82	0.97	0.82
Genitals, nails, and pruritus	r	0.48	0.15	0.01	-0.02	-0.03	1.00	0.06	<0.001
	Pvalue	<0.001	0.27	0.96	0.87	0.82	.	0.65	1.00
Face involvement	r	0.42	0.03	0.03	0.02	0.01	0.06	1.00	-0.01
	Pvalue	<0.001	0.85	0.84	0.85	0.97	0.65	.	0.93
Scalp involvement	r	0.18	0.18	-0.01	0.01	-0.03	<0.001	-0.01	1.00
	Pvalue	0.17	0.18	0.93	0.97	0.82	1.00	0.93	.

* The values in the table represent Spearman's r coefficient. Significant correlations appear in bold.

reduction to identify a small number of factors that explain the variance observed in a much larger number of manifest variables. It is used to screen variables for subsequent analysis. For example, factor analysis may be used to identify co-linearity prior to performing a linear regression analysis. In this study, factor analysis was used to identify the factors that explain most of the variance within BPSS. An item is considered as loaded (within a given factor) when it is above a cutoff value of 0.5.

Reliability analysis

Reliability analysis is used to study the properties of measurement scales and the items that comprise them. It provides information about the relationships between individual items in a scale. In this study we used the alpha (Cronbach's) model of internal consistency, based on the average inter-item correlation, in order to determine the extent to which the items in BPSS factors are related to each other. A cutoff value of 0.7 is used to determine the internal consistency of items within a given factor.

Correlation

Factors that comprise BPSS and PASI were correlated using Spearman's test for statistical significance. Correlation matrices were generated to compare BPSS factors using a pre-defined correlation statistic of ≥ 0.5 as a minimum standard.

Results

The mean age of the 70 study patients (40 men) was 50.8 years (SD 13.8, range 19–78 years). The duration of psoriasis vulgaris was longer than 4 years (range 4–30). The mean duration of climatotherapy at the Dead Sea treatment was 15.2 days (SD 4.8, range 6–33 days). No side effects were recorded during the treatment period.

The ranges, means and standard deviations of PASI, BPSS and items of BPSS are shown in Table 2. PASI was significantly correlated with BPSS treatment (r = 0.59, P < 0.001).

Factor analysis demonstrated that BPSS included six factors [Table 3]. The factors were labeled patient assessment (3 items); physician assessment (4 items); palms and soles involvement (3 items); genitals, nails, and pruritus (3 items); face involvement (2 items); and scalp involvement (1 item). The total explained variance of BPSS was 74.0%. The explained variance for each factor was: patient assessment 26.0%; physician assessment 13.2%; palms and soles involvement 11.9%; genitals, nails, and pruritus 9.0%; face involvement 7.3%; and scalp involvement 6.6%. Total scale Cronbach's alpha was 0.76 [Table 3]. Alpha for each factor was: patient assessment 0.81; physician assessment 0.67; palms and soles involvement 0.46; genitals, nails, and pruritus 0.62; and face involvement 0.39. Correlation matrices were generated to compare BPSS, PASI and BPSS factors [Table 4].

Discussion

Psoriasis is a prevalent dermatological disease associated with considerable physical morbidity and substantial psychological impact on affected individuals. Measuring the severity of psoriasis is imperative for understanding how the disease affects patients' lives. A validated tool should be used for the assessment of psoriasis during everyday clinical practice and research. However, despite decades of studies, there is still no widely accepted instrument for the routine clinical assessment of psoriasis severity [11–16].

The Psoriasis Area and Severity Index [1] is usually used for research and serves as a surrogate for a gold standard, but its disadvantages far exceed its advantages and prevent widespread use in clinical settings. PASI is too long for routine use, does not include quality of life assessment, and does not account for the presence of psoriasis on the face, palms and soles, and genital region [1–5].

It is suggested that a severity score for psoriasis should have the following features: simplicity, universality, the means to assess the distribution of the psoriasis in all body regions, quality of life measures, and global severity indices. Any suggested instrument for the assessment of psoriasis severity should be verified for validity and reliability before wide implementation.

In the current study we used the first version of BPSS [17]. BPSS is a novel instrument for the ambulatory assessment of patients with psoriasis. It includes items of distribution (face, palms and soles, genital areas, nails), items of quality of life, global severity indices, and assessment of pruritus. The design and vali-

dation of BPSS involve multidisciplinary efforts in dermatology, psychology, epidemiology and public health. The presented BPSS version is derived from the first phase in a study whose purpose was to design a simple and useful instrument to assess psoriasis. The study is being conducted prospectively for a planned period of 4 years, with two phases. In the first phase, a preliminary instrument for the assessment of psoriasis (BPSS, Version 1) was introduced. In our previous study we demonstrated the criterion validity of BPSS and its responsiveness [17].

The present BPSS version has been used routinely since 2002 in psoriatic patients in the southern district of Clalit Health Services in Israel who receive climatotherapy at the Dead Sea. In the current study, we investigated BPSS factors using factor analysis and internal consistency analysis (Cronbach's alpha). Factor analysis demonstrated that BPSS included six factors. The factor labeled patient assessment included three items that correspond to the patients' assessment of total severity, both physical and psychological. The factor labeled physician assessment included four items that reflect the physicians' assessment of the skin involvement of the limbs and trunk, and physicians' total severity assessment. The factor labeled palms and soles involvement included three items that address palms and soles involvement as assessed by the patients and the physicians. The factor labeled face involvement included two items that assess face involvement (one by the patients and one by the physicians). All these factors had high item loadings and are consistent with our concept of psoriasis severity.

The factor labeled genitals, nails, and pruritus included three items. The involvement of genitals and nails had high item loadings (0.80 and 0.77, respectively), whereas pruritus had low loading of less than 0.5. In our view of psoriasis severity, there is no plausible association between these items. It is possible that data on genital involvement may be misrepresented as patients sometimes fail or refuse to adequately complete this item.

A factor composed of one item – scalp involvement – appeared as a principal component of our final model of BPSS. When the number of factors was limited to 3, 4, 5, or 7 factors in other iterations, scalp involvement was always a significant factor in BPSS (data not shown).

Internal consistency, measured by Cronbach's alpha, was high in two factors: patient assessment and physician assessment. However, internal consistency was low in the factor genitals, nails, and pruritus, which is not surprising since these items have no dermatological rationalization for their grouping. Internal consistency was low in palms and soles involvement and in face involvement, probably due to the small sample size.

A correlation matrix comparing BPSS, PASI and BPSS factors demonstrated that PASI correlated with only two factors: patient and physician assessments, whereas BPSS was correlated with all the factors except for scalp involvement. This observation suggests that PASI does not characterize important themes in physicians' and patients' assessment of the disease that include palms and soles, genital and face involvement and the degree of pruritus, whereas all these factors are associated with BPSS.

In summary, in the current study we have demonstrated that the BPSS is constructed of six factors that explain most of the scale's total variance. These factors include patient assessment, physician assessment, palms and soles involvement, and face involvement. We suggest that BPSS may be used for measuring psoriasis severity in routine clinical practice.

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