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Harald Krauss · Karen Marwinski · Tilo Held
Marcella Rietschel · Harald J. Freyberger

Reliability and validity of the Premorbid Adjustment Scale (PAS) in a German sample of schizophrenic and schizoaffective patients

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Abstract Premorbid functioning seems to be a phenomenological marker that possibly distinguishes a subtype of schizophrenia. The Premorbid Adjustment Scale (PAS) is an instrument for measuring premorbid functioning. It has gained international acceptance, although little is known about the reliability and validity of the test. Here data on the reliability and validity of the test derived from a German sample of schizoaffective and schizophrenic subjects (n = 86) and their healthy parents (n = 38) is presented. The DSM-IV diagnosis, PAS and Positive and Negative Syndrome Scale (PANSS) data were used as well as data on the course of the disorder. The estimation of the reliability per scale by internal consistency showed high positive values of Cronbach's α between 0.809 and 0.931. High scores in PAS representing a bad premorbid social adjustment correlated significantly with a low age of onset, high PANSS scores, an insidious onset and a long period of hospitalisation. The disorganised DSM-IV subtype of schizophrenia showed a trend towards higher mean PAS scores. In the presented sample, the threshold between schizophrenics and healthy individuals is at 0.23. The PAS values higher than 0.53 appeared in patients with an unfavourable course of the disorder. These findings correspond with previous reports in the literature.

Key words Premorbid functioning · Schizophrenia · Schizoaffective disorder · German version of the Premorbid Adjustment Scale (PAS) · Positive and Negative Syndrome Scale (PANSS)

H. Krauss (✉) · K. Marwinski · M. Rietschel
Klinik und Poliklinik für Psychiatrie und Psychotherapie,
Rheinische Friedrich-Wilhelms-Universität Bonn,
Sigmund-Freud-Strasse 25, D-53105 Bonn, Germany
e-mail: Krauss@Uni-Bonn.de,
Tel.: +49-228-287-5712, Fax: +49-228-287-6097

T. Held
Rheinische Kliniken Bonn, Kaiser-Karl-Ring 20,
D-53111 Bonn, Germany

H. J. Freyberger
Klinikum der Hansestadt Stralsund,
Klinik und Poliklinik für Psychiatrie und Psychotherapie
der Ernst-Moritz-Arndt-Universität Greifswald,
Rostocker Chaussee 70, D-18437 Stralsund, Germany

Introduction

Bleuler spoke of the "group of schizophrenias", meaning that there must be different subtypes, each with different underlying causes. Although various subtypes have been postulated and suggested, there is no consensus on this subject as the underlying causes are unknown. Nevertheless, one possible subtype seems to be consistently emerging from findings in research [4]. This possible subtype seems to show deficits in premorbid functioning, an early [11], insidious [2] onset, a long course of disorder [1, 10], neurological "soft signs", inconsistent morphological findings in the brain [6] and the development of a "negative" deficit syndrome [1, 9–11] with a decay in personality. Against this background, the Premorbid Adjustment Scale (PAS) was introduced by Cannon-Spoor et al. [2]. Contrary to other instruments for measuring social functioning and adjustment, the PAS is focused on the premorbid period of life. The PAS has been accepted internationally as a gold standard (for a synopsis of the different instruments see [3]). All of the previously cited findings were obtained with the help of the PAS.

Apart from the initial publication by Cannon-Spoor et al. [2], no data is available on the reliability and validity of the instrument. Here such data is presented, derived from a German sample.

Materials and methods

The PAS is a scale to assess social adjustment before the onset of schizophrenia. In this investigation, a German version translated and adopted by our group was used that considered characteristics of the European and German culture such as the different education. The PAS consists of four different subscales covering different periods of age (childhood, early and late adolescence, adulthood) and a fifth general subscale. The items cover social accessibility: isolation, peer relationships, ability to function outside the nuclear family and capacity to form intimate socio-sexual ties. The

Table 1 DSM-IV diagnosis (n = 86)

	n	%
No psychiatric disorder	38	
Schizophrenia, disorganised type (295.1)	8	9
Schizophrenia, paranoid type (295.3)	60	70
Schizoaffective disorder (295.7)	18	21

general section contains items meant to estimate the highest level of functioning that the subject achieved before becoming ill, the time span and characteristics of onset of illness and general information such as level of education [2].

The lifetime diagnosis of any psychiatric illness was made by a translated and modified Schedule for Affective Disorders and Schizophrenia Lifetime Version (SADS-L interview) by Grabe et al. [5]. Additional data was obtained regarding the age of onset, the course of disorder, as well as the number and the total duration of psychiatric hospitalisations over lifetime. The number of years since onset of the disorder results from the difference between age of onset and age at interview. For further validation of the instrument, data by the Positive and Negative Symptom Scale (PANSS) [7] were assessed prior to discharge.

All subjects were rated on the basis of a personal interview and by the best-estimate method, including all other available sources of information. There were no major differences in self- or third-persons assessment corresponding to the findings of Cannon-Spoor [2]. The data were evaluated in terms of the consensus method by an independent second rater blind to the previous evaluation. In case of differences, a third independent rater was consulted.

Subjects

Seventy-one male and 53 female subjects (n = 124) were rated, of whom 86 received a lifetime DSM-IV diagnosis of schizophrenia or schizoaffective disorder (Table 1). Subjects with comorbidity were excluded. The remaining 38 subjects were parents of the patients who had never suffered from a psychiatric disorder. The group of the parents was taken as a healthy comparative group. Therefore, an inevitable significant difference in age between both groups resulted ($t_{(122)} = 11.029$, $p = 0.000$).

The clinical subjects aged on average 39 years (SD = 11.2 years), the healthy individuals 64 years (SD = 12.3 years). As expected, the average test scores of PAS and PANSS showed a significant difference between both groups (Table 2); the clinical subjects showed unequivocal higher scores than the group of healthy subjects in both tests.

There was no significant difference in the distribution of men and women between the groups of healthy and clinical subjects ($\chi^2_{(1)} = 2.19$, $p = 0.139$).

Statistics

After the determination of the mean positive covariance of the items per scale, the reliability of the five subscales could be proofed by the estimation of the internal consistency by Cronbach's α. Afterwards, the bivariate intercorrelation between the PAS subscales and the test scores of the PAS and the PANSS were looked at and tested for two-tailed significance. For the items of both tests the level of interval scales was assumed so that a product-moment correlation coefficient by Pearson as a measure of linear correlation could be used.

For testing whether the PAS scores were able to predict the PANSS scores, the multiple linear regression analysis was used. The interdependence of the subscales had to be considered while interpreting the single bivariate correlation, particularly between the PAS subscales and the PANSS test score. Since multicolinearity must be assumed because of the bivariate correlation analysis, a principal component analysis (PCA) was performed on the group of patients (excluding the healthy subjects) to avoid suppression effects. However, only clinical subjects with an age of onset beyond 18 years could be considered here because only on these subjects could all items be rated. The determination of the number of factors of meaning in the PCA was made by a Scree test. The considerable factors of the PCA were Varimax rotated for getting a better opportunity for interpretation, so that a good simple structure by Thurstone resulted. The considerable factors were then used for a multiple regression analysis, although it must be considered that with this procedure the total variance of the items cannot be explained.

Additionally, the PAS was related to other variables such as gender, DSM-IV diagnosis, age of onset, course of disorder and the total duration of hospitalisation over lifetime. For testing hypothetical differences between two groups the t-test for independent samples was performed as a parametric method. In case of too-small sizes of the groups or too-big differences between the sizes, alternatively the U-test by Mann-Whitney as a non-parametrical method was performed. With nominal scaled variables the χ^2 test was performed. Association hypotheses were tested by calculating the bivariate correlation. Depending on the level of the scales of the variables examined, either the product-moment correlation coefficient by Pearson for interval data, or the rank correlation coefficient by Spearman, was determined and tested for two-tailed significance.

A significance level of 1% for all calculations was fixed previously.

Results

The results of the estimation of the PAS subscales (relative scores of the scales) by Cronbach's α is shown in Table 3. The general subscale was looked at separately for the healthy and the clinical subjects, because of the inapplicable items referring to the disorder. All together, high α scores appeared in this sample, so that the internal consistency of the scales is given for our sample.

The intercorrelation of the PAS subscales (Table 4) showed significantly high positive values. The linear correlation between the PAS subscales and the PAS test score turned out to be high positive. The bivariate correlations between the PAS subscales, the PAS test score and the PANSS test score lay in a middle-positive range. All linear correlations were significant (common shared variance 33.6–42.6%).

In the PCA the number of factors was decided to be five because of Scree test results. The results of the loads after Varimax rotation are shown in Table 5. All together, the five factors cleared up 71.2% of the total variance. Contrary to the original PAS scales, these factors were less time bound than orientated to a subject.

Table 2 PAS and PANSS test scores

PAS	Disordered	M = 0.477 (SD = 0.165)	$t_{(121)} = -11.57$	$p < 0.001$
	Healthy	M = 0.229 (SD < 0.001)		
PANSS	Disordered	M = 51.24 (SD = 14.17)	$t_{(121)} = -13.81$	$p < 0.001$
	Healthy	M = 30.11 (SD = 0.65)		

In the following multiple regression analysis, the PANSS test score was to be predicted by means of the five factors. It led to a significant multiple correlation of 0.44 ($F_{5,84} = 3.788$; $p = 0.004$) and an R-square (R^2) of 0.193. Because the multiple correlation found in a sample tend to be overestimated a correction for shrinkage was necessary. The adjusted R-square ($R^2_{adjusted}$) was 0.142. This means that 14.2% of the total variance of the criteria variables could be predicted. Approximately 85.8% remained unexplained by the predictors. Table 6 shows the standardised β-weights of the single predictors and their significance, and shows that only the predictors "interpersonal bindings in childhood and early adolescence" and "self-assertion" contributed significantly to the prediction of the PANSS test score. Both predictors entered with a middle-positive weight into the linear regression analysis. This means that an increase in both factors led to an increase in the predicted PANSS test scores, whereas the factor "self-assertion" figured slightly stronger in the pre-

Table 3 Analysis of the reliability of the PAS subscales by Cronbach's α

PAS subscale	Mean inter-item covariance	Cronbach's α
Childhood	1.628	0.832
Early adolescence	1.460	0.828
Late adolescence	1.676	0.876
Adulthood	2.672	0.931
General (group of patients)	1.186	0.839
General (group of healthy subjects)	0.239	0.809

Table 4 Significant correlation of the PAS subscales, the PAS test scores and the PANSS test scores. (*C* childhood; *EA* early adolescence; *LA* late adolescence; *A* adulthood; *G* general; *T* test score)

Scale/test score	PAS-EA	PAS-LA	PAS-A	PAS-G	PAS-T	PANSS test score
PAS-C	0.9334	0.876	0.751	0.711	0.902	0.601
PAS-EA		0.954	0.864	0.793	0.958	0.610
PAS-LA			0.897	0.839	0.969	0.569
PAS-A				0.851	0.928	0.645
PAS-G					0.923	0.619
PAS-T						0.653

Table 5 Varimax-rotated loading for the five PAS factors and their eigenvalues λ (only items with loading > 0.5) (*C* = childhood; *EA* early adolescence; *LA* late adolescence; *A* adulthood; *G* general)

Factor 1 (λ = 8.164): interpersonal relation in late adolescence and adulthood		
A1	Sociability and withdrawal	0.87
A2	Peer relationship	0.86
A3	Aspects of adult social-sexual life	0.83
LA2	Peer relationship	0.76
LA1	Sociability and withdrawal	0.75
LA5	Social aspects of sexual life	0.71
Factor 2 (λ = 4.39): interpersonal relation in childhood and early adolescence		
C1	Sociability and withdrawal	0.87
EA1	Sociability and withdrawal	0.86
C2	Peer relationship	0.80
EA2	Peer relationship	0.80
Factor 3 (λ = 2.48): scholastic performance and adjustment in school		
EA3	Scholastic performance	0.85
C3	Scholastic performance	0.83
EA4	Adaptation to school	0.80
C4	Adaptation to school	0.75
LA3	Scholastic performance	0.64
LA4	Adaptation to school	0.57
Factor 4 (λ = 1.82): self-assertion		
G9	Energy level	0.79
G8	Degree of interest in life	0.79
G7	Social-personal adjustment	0.75
G5	Establishment of independence	0.74
G1	Education	0.55
Factor 5 (λ = 1.67): prodromal changes		
G2	Employed or in school prior to onset	0.82
G4	Frequency of job change or school attendance prior to onset	0.76
G6	Highest level of functioning	0.62
G3	Change in work or school performance prior to onset	0.62

Table 6 Standardised β-weights of the independent predictors and their significance test by an approximate *t*-distributed test statistic with *df* = 80 (*C* childhood; *EA* early adolescence; *LA* late adolescence; *A* adulthood)

Predictors	Standard β-weights	*t*-value	Two-tailed *p*-values
Interpersonal relation in A and LA	–0.083	–0.826	0.411
Interpersonal relation in C and EA	0.290	2.874	0.005
Scholastic performance and adjustment in school	0.111	1.099	0.275
Self-assertion	0.298	2.948	0.004
Prodromal changes	0.032	0.318	0.751

diction of the criteria variables than the second significant factor.

When looking at the correlation between age of onset and PAS test score in the group of patients, a significant low negative correlation ($r = –0.344$; $p = 0.001$) appeared: thus, PAS test scores are higher in patients with a low age of onset. The subdivision into age of onset before and after the age of 20 years led to a significant difference in the PAS test score ($t_{(86)} = 2.724$; $p = 0.008$). The mean of the patients who became disordered before the age of 20 years (M = 0.52; SD = 0.160) was higher than that of the patients with an age of onset after the age of 20 years (M = 0.43; SD = 0.167). Conversely, there was no significant difference between both groups in the PANSS test score ($t_{(86)} = 1.486$; $p = 0.148$).

Relating the PAS test score to the course of the disorder, a middle-positive correlation resulted ($\rho = 0.572$; $p < 0.001$). Thus, patients with a progressive course of the disorder had higher PAS test scores. After considering in an episodic (M = 0.381; SD = 0.109) and a chronic (M = 0.534; SD = 0.166) course, a significant difference ($t_{(79)} = 5.0$; $p < 0.001$) in the PAS values resulted.

Looking at the difference in the time of onset of the disorder within the group of patients (sudden onset up to 3 months vs insidious onset from 1 year on) by using the Mann-Whitney U-test, a significant difference (U = 174; Z = –3.505; $p < 0.001$) was observed. Patients with an insidious onset ($n = 19$) showed a higher PAS test score on average (M = 0.572; SD = 0.178) than the control group ($n = 42$; M = 0.405; SD = 0.122) with a sudden onset.

The total duration of hospitalisation in life correlated significantly positive with the PAS values ($\rho = 0.476$; $p < 0.001$). In fact, the total duration of hospitalisation also correlated significantly with the number of years since onset of the disorder (age at interview minus age of onset, $\rho = 0.47$; $p < 0.001$), but the number of years since onset did not correlate significantly with the PAS test scores ($\rho = 0.113$; $p = 0.305$).

A significant difference between the DSM-IV subtypes (disorganised, paranoid, schizoaffective) was not observed for their mean PAS test scores because of a high overlapping area. The middle PAS test scores were 0.44 in schizoaffectives (SD = 0.15), 0.48 in paranoid (SD = 0.17) and 0.55 in disorganised patients (SD = 0.18).

Clinical female subjects showed marginally lower PANSS scores than male subjects without significance ($t_{(84)}$; $p = 0.193$). There was no significant difference in the average PAS scores related to the gender of the subjects (male, $n = 52$; M = 0.474; SD = 0.164; female, $n = 33$; M = 0.483; SD = 0.171; $t_{(84)} = 0.24$; $p = 0.815$).

Discussion

In the original publication of the PAS, Cannon-Spoor et al. [2] provided data on the objectivity, the validity of the test, the selectivity of the items and the interrater reliability. Besides this information, no data has been published on the criteria of the test. Furthermore, Cannon-Spoor et al.'s [2] approach might be seen as problematic because the interdependence of the items of the PAS is not considered and, therefore, their results might not be taken as reliable. This investigation was performed to produce data on the validity and reliability of the PAS derived from a German sample of schizophrenic and schizoaffective patients and their healthy parents using a German version of the test adapted by our group.

The estimation of the reliability by the internal consistency showed high positive values (Cronbach's $\alpha > 0.8$) for this sample. Thus, there was a high covariance of the original subscales which are not grouped thematically. The original subscales summarise items different in content over a certain period of age. The matter of the items repeat in different subscales. Thus, a high interdependence and a low variance is observed between the original subscales. Therefore, the scores of the subscales could not be taken to predict the PANSS. Still trying to predict the PANSS on the basis of the original subscales by eliminating the mutual variance would mean to consider only the items of the childhood, because of the direction of the influence of the items due to age.

Because of this interdependence of the original subscales, five independent dimensions derived from the PCA which explained 70% of the total variance: (a) interpersonal relationship in childhood and early adolescence; in (b) late adolescence and adulthood; (c) scholastic performance and adaptation in school; (d) self-assertion; and (e) prodromal change. In the regression analysis, the factors self-assertion and interpersonal relationship in childhood and early adolescence contributed in predicting the PANSS score. But, as expected, there was only a middle-range correlation between the factors and the PANSS. Furthermore, only those patients who had a full set of rated items, as well as those whose age of onset was beyond 18 years, could be considered for the principal component analysis. Consequently, the middle-range correlation between the factors and the PANSS scores cannot be

generalised. Nevertheless, it could be considered if these factors can still be the basis of an alternative evaluation strategy contrary to the original subscales, especially because there is a high mutual dependence on the original subscales. Other investigators also found similar factors to be decisive [3, 10].

The group of the parents was taken as a healthy comparative group. With regard to the theoretical interdependence of the parental group upon the group of patients, they could be considered as not being an optimal control group. On the other hand, the high significant differences found in both groups argue against that point. Additionally, only older subjects can be considered as healthy over lifetime. The parents of the patients showed significantly low PAS scores throughout with a low standard deviation; thus, this group could be taken for comparison. To what extent the interaction between the healthy parents and their ill-becoming children influenced the PAS scores or whether there are other – maybe biological – causes [11] was not a subject of this investigation and remains an unanswered question.

In this sample the threshold between healthy and clinical subjects was 0.23; a PAS score higher than 0.53 appeared in patients with an unfavourable course.

The results confirm previous findings of high PAS scores correlating significantly with an early age of onset [11]; thus, the patients with a bad premorbid adjustment showed an earlier age of onset. In the same way, high PAS scores correlated significantly with high PANSS scores as an expression of a "negative syndrome" [1, 9–11], with insidious course and a long total duration of hospitalisation over lifetime [1, 10]. Thus, the patients of our sample with a bad premorbid adjustment showed a clinical course with an insidious onset, a long duration of hospitalisation and remaining negative symptoms at discharge.

In addition, there was no significant correlation between all of these variables so that the PAS score had to be seen as the common reference point. It had to be considered that patients with a long clinical course were more likely to have a higher total duration of hospitalisation. As expected, a significant correlation between the total duration of hospitalisation and the years since onset of the disorder was observed; yet, there was no significant correlation between the years since onset of the disorder and the PAS scores. Thus, the number of years since onset of the disorder seems to influence the total duration of hospitalisation over lifetime as well as the premorbid adjustment, but both influence the duration of hospitalisation independently from each other.

A relation between the DSM-IV subgroups of diagnosis and the PAS scores could only be shown in tendency because of the high standard deviations: the group of disorganised schizophrenics showed the highest mean PAS score.

A bad premorbid adjustment and a serious course of disorder with the development of a deficit syndrome could be interpreted as either an entity of its own, or as an independent variable just influencing the course of the disorder independently of the underlying causes, or as a prodromal state [9]. Which of these three assumptions turns out to be true must stay open until the underlying causes are discovered. However, the hypothesis of a subtype might be supported by the circumstance that the findings and connections are reproduced consistently [4, 6].

Furthermore, a bad premorbid adjustment seems to be a predictor for a certain serious type of course of disorder with the development of a negative-deficit syndrome. Regarding previous findings and the present findings, this development could be predicted by the PAS [1].

It must be stated emphatically that there is not yet a standardisation and calibration of the PAS to a representative sample. To what extent this is necessary for a so-called special test for the purpose of research regarding the many positive findings might be controversial.

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