Factor Structure of the Positive and Negative Syndrome Scale (PANSS) Differs by Sex

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Abstract

Although the Positive and Negative Syndrome Scale (PANSS) is widely used in clinical research, factor analytic studies of the scale have been inconsistent and questions remain about the underlying factor structure of schizophrenia symptoms. The purpose of this study was to examine whether the factor structure of the PANSS differs in men and women with schizophrenia. Principal components analysis (PCA) with equamax rotation was used to examine the factor structure of the PANSS separately in 124 males and 74 females with schizophrenia-related psychoses. In males, a four-factor structure was identified: 1) Negative, 2) Cognitive, 3) Positive, and 4) Hostility. In females, a four-factor structure also emerged: 1) Negative, 2) Cognitive, 3) Positive, and 4) Depression. The most notable difference between the male and female PCAs was the presence of a depression factor in the females and a hostility factor in males. These results support sex differences in the factor structure of schizophrenia symptoms, which has important implications for clinical research.

Key Words: Schizophrenia, Statistics, Rating Instruments, Sex Differences

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Introduction

The Positive and Negative Syndrome Scale (PANSS) (1) is widely used in clinical research to assess change in level of psychopathology and treatment efficacy. The scale has been studied extensively to determine the best way to categorize the underlying symptom constructs associated with schizophrenia. The majority of studies support a five-factor model of the PANSS (2-14), but with inconsistencies across items and factors. In an effort to develop a consensus from these inconsistencies, Wallwork and colleagues (12) tabulated item loadings from studies that yielded a five-factor model and, based on those findings, developed a five-factor consensus model that was supported by confirmatory factor analyses (CFA). However, other factor studies have supported four- (15), six- (16), seven- (17), and eight- (18) factor models and, because of poor replication, questions about the underlying factor structure remain.

Sex differences in the symptomatology and course of schizophrenia are well documented in the literature (reviewed in [19-21]). Yet the PANSS was initially validated in

Clinical Implications

The results of this study support sex differences in the factor structure of the PANSS that may have contributed, at least in part, to prior conflicting factor analytic studies. The implications of the findings, if replicated, may be that separate male and female treatment research is necessary to find optimal sex-specific treatments for schizophrenia. These findings may have particular relevance for clinical trials, which often use the PANSS as an outcome measure, as treatment effects may be mitigated in females if scales that more accurately capture male symptomatology are used. The implication of these findings may also extend beyond treatment studies, as understanding sex-specific symptomatology may enhance our understanding of the neurobiological underpinnings of the disease as well as risk and protective factors. Future research should account for sex differences when examining the effects of treatments for schizophrenia, as well as investigating etiology and evaluating other factors affecting course and outcome within the disease.

a sample consisting of 70% males (1), and the majority of factor analytic studies of the measure were conducted with male-predominant (>70% male) samples (2, 6, 7, 9-11, 14-16). Thus, the factor structure of this scale may not account for differences in symptom presentation between women and men. In their development of a recent PANSS consensus model, Wallwork et al. (12) examined sex by comparing male and female mean scores across the consensus factors, finding only higher negative symptom factor scores in males. But the authors did not examine sex differences in the factor structure itself, as their analysis to test the consensus model was conducted on a combined sample of males and females.

Only one previous study has specifically examined sex differences in the PANSS factor structure by running separate analyses by sex, finding possible sex differences in the cognitive and excitement factors, but concluding that, overall, there were minimal differences (22). However, the study's approach was limited in that they used items derived from previous factor analyses and tested whether or not the goodness of fit differed between the sexes. The purpose of this study was to perform separate exploratory factor analyses for males and females with schizophrenia to examine whether sex differences exist in the factor structure of the PANSS.

Methods

Participants included 124 male and 74 female inpatients at a large medical center in the northeast United States with a *DSM-IV* diagnosis of schizophrenia or schizoaffective disorder. Diagnosis was ascertained with the Diagnostic Interview for Genetic Studies (DIGS) (23). All clinical assessments were conducted by Master's or Doctorate level clinicians who were trained to maintain a reliability criterion of at least .70. Clinical diagnoses were made by a consensus of at least two doctoral level research-clinicians (MD or PhD) and the interviewer. Psychiatric symptoms were assessed with the Positive and Negative Syndrome Scale (PANSS) (1). Cognition was assessed with the Wechsler Adult Intelligence Scale, Third Edition (WAIS-III) (24) and the Wechsler Memory Scale, Revised (WMS-R) (25). All participants had been taken off medication for either clinical or research purposes, and were medication free for at least three weeks at the time of the PANSS rating. The study was approved by the local Institutional Review Board and all participants signed informed consent.

Data Analysis

Data analysis was conducted using SPSS 17.0. We initially ran principal components analyses (PCA) with oblique (oblimin) rotation separately for the male and female PANSS symptom ratings. However, the factor correlations were low (<0.32), suggesting that the factors were orthogonal (26) and, therefore, orthogonal rotation was more appropriate. It was decided to use PCA with equamax rotation (27) for the final analyses, which is a more conservative approach as it combines varimax rotation, which simplifies the factors, and quartimax, which simplifies the variables. The first analysis for males and females did not limit the number of factors. Subsequent analyses limited the number of factors to four based on observation of the initial scree plot (28) and eigenvalues (>1) (29). Items that did not load highly (≥0.40) on any factor or loaded highly on more than one factor were excluded and the PCA was repeated until at least three items loaded on each factor and simple structure was maintained.

Results

Demographic information is displayed in Table 1. Males and females did not differ with regard to current age, education, race, diagnosis, and cognitive function. However, males had significantly younger age of onset, which is consistent with the literature. Males and females did not differ with regard to PANSS positive, general psychopathology, and total symptom ratings, although males tended to have higher negative symptom ratings than females.

Male PCA Results

We first examined the factorability of the PANSS items. The Kaiser-Meyer-Olkin measure of sampling adequacy was .81, above the recommended minimum value of .50 (30).

Table 1 Demographic Characteristics, Cognitive Function, and Psychiatric Symptoms for Male and Female Cases

	Males		Females			
	N	M (SD)	N	M (SD)	t	p
Age	123	31.85 (10.79)	74	33.24 (8.88)	0.99	.326
Age of Illness Onset	120	20.48 (6.25)	73	22.74 (8.33)	2.00	.048*
Years of Education	119	13.03 (2.74)	70	13.56 (2.75)	1.29	.199
Duration of Psychotic Symptoms	119	11.7 (10.6)	73	10.7 (9.6)	0.64	.523
Wechsler Adult Intelligence Scale, Third Edition (WAIS-III)						
Full Scale IQ	65	88.75 (13.37)	40	87.08 (16.22)	0.58	.566
Verbal IQ	65	91.85 (13.99)	40	89.75 (16.75)	0.69	.491
Performance IQ	65	84.88 (15.03)	40	85.13 (15.59)	0.08	.936
Wechsler Memory Scale-Revised (WMS-R)						
General Memory Index	66	88.10 (20.38)	41	86.59 (18.74)	0.38	.703
Positive and Negative Syndrome Scale (PANSS)	123		74			
Positive		17.44 (6.61)		18.50 (7.28)	-1.06	.293
Negative		16.52 (7.10)		14.72 (6.86)	1.78	.085
General Psychopathology		32.34 (11.11)		34.72 (12.54)	-1.40	.163
Total		66.21 (21.38)		66.96 (21.53)	-2.45	.815
	N	%	N	%	X^2	p
Race					5.83	.323
White	60	48.4	28	37.8		
Hispanic	31	25	18	24.3		
Black	22	17.7	22	29.7		
Asian/Pacific Islander	4	3.2	4	5.4		
Native American	5	4	1	1.4		
Other	2	1.6	1	1.4		
Diagnosis					7.72	.102
Schizophrenia-Undifferentiated	47	37.9	18	24.3		
Schizophrenia-Paranoid	35	28.2	32	43.2		
Schizophrenia-Disorganized	7	5.6	2	2.7		
Schizoaffective-Depression	19	15.3	7	9.5		
Schizoaffective-Mania	10	8.1	13	17.6		
Other Psychosis†	6	4.8	2	2.7		

*p<.05; †includes psychosis NOS, SCZ-Catatonia, and SCZ-Residual

Bartlett's test of sphericity was significant ($\chi^2(435)=1719.50$, p<.01). Based on these measures, we proceeded with the PCA.

The initial rotation for the male PCA resulted in seven factors accounting for 65.23% of the total variance. After removing non-loading and double-loading items, a four-factor structure with loadings ≥0.40 was supported, resulting in 25 items and accounting for 54.54% of the total variance: seven items loaded on a *Negative* factor (25.90% of the total variance), seven items loaded on a *Cognitive* factor (12.01% of the total variance), six items loaded on a *Positive* factor (9.84% of the total variance), and five items loaded on a *Hostility* factor (6.75% of the total variance; see Table 2 for item loadings). Cronbach's alpha coefficients for the

Table 2 Factor Loadings of the PANSS Items From the Male Principal Components Analysis

	NEG	COG	POS	HOS
N1. Blunted Affect	.817			
N6. Lack of Spontaneity and Flow of Conversation	.805			
G7. Motor Retardation	.803			
N4. Passive/Apathetic Social Withdrawal	.714			
N2. Emotional Withdrawal	.709			
N3. Poor Rapport	.663			
G5. Mannerisms and Posturing	.546			
G11. Poor Attention		.790		
G10. Disorientation		.746		
P2. Conceptual Disorganization		.699		
G15. Preoccupation		.596		
G4. Tension		.533		
G13. Disturbance of Volition		.466		
N7. Stereotyped Thinking		.458		
G6. Depression			.757	
P6. Suspiciousness/Persecution			.709	
P1. Delusions			.685	
G3. Guilt			.675	
G2. Anxiety			.547	
P3. Hallucinatory Behavior			.510	
G8. Uncooperativeness				.775
G14. Poor Impulse Control				.735
P4. Excitement				.627
P7. Hostility				.511
G12. Lack of Judgment and Insight				.460
Cronbach's Alpha	**.867**	**.833**	**.756**	**.720**

NEG=Negative; COG=Cognitive; POS=Positive; HOS=Hostility

Table 3 Correlations Between Male PANSS Factors

	Negative		Cognitive		Positive	
	r	p	r	p	r	p
Negative	-	-	-	-	-	-
Cognitive	.397	.000†	-	-	-	-
Positive	.212	.019*	.363	.000†	-	-
Hostility	.248	.006†	.467	.000†	.163	.071

*p<.05; †p<.01

four factors were as follows: *Negative*=.867, *Cognitive*=.833, *Positive*=.756, and *Hostility*=.720. Pearson correlation coefficients were calculated between the four scales, with the highest correlations found between the *Cognitive* and *Hostility* factors (r=.467; p=.000), followed by the *Negative* and *Cognitive* factors (r=.397; p=.000), the *Cognitive* and *Positive* factors (r=.363; p=.000; see Table 3). These moderate intercorrelations are suggestive of a relatively orthogonal factor structure and that the subscales are tapping distinct dimensions of psychiatric symptoms (31).

Female PCA Results

We again examined the factorability of the PANSS items. The Kaiser-Meyer-Olkin measure of sampling adequacy was .72 and Bartlett's test of sphericity was significant ($\chi^2(435)=1259.14$, p<.01). Based on these measures we proceeded with the female PCA.

The initial rotation for the female PCA resulted in eight factors accounting for 70.42% of the variance. After removing non-loading and double-loading items, a four-factor structure with loadings ≥0.40 was supported, resulting in 21 items and accounting for 59.54% of the total variance: seven items loaded on a *Negative* factor (20% of the total variance), seven items loaded on a *Cognitive* factor (19% of the total variance), five items loaded on a *Positive* factor (14% of the total variance), and three items loaded on a *Depression* factor (7% of the total variance; see Table 4 for item loadings). Cronbach's alpha coefficients for the four factors were as follows: *Negative*=.886, *Cognitive*=.851, *Positive*=.760, and *Depression*=.475. Pearson correlation coefficients were calculated between the four scales, with the highest correlations found between the *Negative* and *Cognitive* factors (r=.381; p=.001), followed by the *Cognitive* and *Positive* factors (r=.299; p=.010) and the *Depression* and *Positive* factors (r=.170; p=.148; see Table 5). Again, these intercorrelations are suggestive of a relatively orthogonal factor structure and that the subscales tap distinct dimensions of psychiatric symptoms (31).

Discussion

This preliminary study used exploratory PCA to separately examine the factor structure of schizophrenia symptoms for male and female cases, as assessed with the PANSS. Four separate factors were identified in male and female groups, but only three factors (Negative, Positive, and Cognitive) were consistent across the sexes, albeit with some variation in specific item loadings. The fourth factor differed across the sexes, with a Hostility factor emerging in males and a Depression factor identified in females. These results suggest sex differences in the factor structure of schizophrenia symptoms.

Table 4 Factor Loadings of the PANSS Items From the Female Principal Components Analysis

	NEG	COG	POS	DEP
N2. Emotional Withdrawal	.848			
N6. Lack of Spontaneity and Flow of Conversation	.814			
N1. Blunted Affect	.781			
N3. Poor Rapport	.758			
N4. Passive/Apathetic Social Withdrawal	.749			
G7. Motor Retardation	.716			
P4. Excitement		.873		
P7. Hostility		.747		
G14. Poor Impulse Control		.727		
P2. Conceptual Disorganization		.710		
G11. Poor Attention		.703		
G10. Disorientation		.608		
G5. Mannerisms and Posturing		.530		
P1. Delusions			.810	
P6. Suspiciousness/Persecution			.710	
P3. Hallucinatory Behavior			.653	
G1. Somatic Concern			.632	
G9. Unusual Thought Content			.631	
G12. Lack of Judgment and Insight				-.656
G3. Guilt				.614
G6. Depression				.595
Cronbach's Alpha	**.886**	**.851**	**.760**	**.475**

NEG=Negative; COG=Cognitive; POS=Positive; HOS=Hostility

Table 5 Correlations Between Female PANSS Factors

	Negative		Cognitive		Positive	
	r	p	r	p	r	p
Negative	-	-	-	-	-	-
Cognitive	.381	.001†	-	-	-	-
Positive	.146	.214	.299	.010*	-	-
Depression	.016	.891	-.131	.267	.170	.148

*p<.05; †p<.01

Three of the items that loaded on the Hostility factor in males (*excitement, hostility, and poor impulse control*) were associated with cognitive items in females, suggesting that aggressive behavior in women with schizophrenia may be associated with cognitive dysfunction. In contrast, aggression in males with schizophrenia was separate from cognitive dysfunction, suggesting that it is a distinctly separate and measurable factor. While these findings are consistent with sex differences in the general population for aggression (reviewed in [32]), they differ from studies that demonstrate increased aggressive behavior in females with schizophrenia (reviewed in [33]). The results do offer a possible explanation and potential target for treatment of this increased violence in females with schizophrenia, as the aggressive behavior may result from cognitive dysfunction and perhaps may diminish with cognitive improvement. In males, *depression* loaded on the Positive factor, suggesting that higher rates of depression in males with schizophrenia may be associated with more positive symptoms, while in women depression is a separate factor. Again, this is consistent with literature suggesting higher rates of affective symptoms in women compared to men (reviewed in [34]).

It is also interesting to note that *lack of judgment and insight* loaded negatively on the Depression factor in females and showed opposite sex-dependent loadings with the male Hostility factor. This is consistent with a model in which males with poor insight would show increased externalized behavior (aggression), whereas females with greater insight would show internalized behavior (depression). It should be noted that the Cronbach's alpha, a measure of internal consistency, is low for the Depression factor. Previous studies have also reported low alphas for the depression factor (3, 16, 17), suggesting that, in general, this scale may tend to be unreliable. However, the Cronbach's alpha (.475) in the present study is problematic as it is less than .6, which is considered the minimal cut-off for an acceptable alpha (35). This finding could be the result of one or more factors that may affect the internal consistency of a scale. The depression factor has only three items and it's possible that the low number of items could be affecting the internal consistency (36). It's also possible that one or more of the items are not contributing to the internal consistency of the factor due to poor interrelatedness between items. However, each of the three items that comprise this factor in the present study are highly correlated with the scale itself (all p's<.001), suggesting that poor interrelatedness is a less likely explanation (37). Still, due to the poor reliability of the Depression factor, it's possible that replication would be difficult in future research.

There are additional limitations associated with the present study that should be recognized. First, the male sample was larger than the female sample, which could have impacted the results. Second, both sample sizes are small, possibly resulting in a factor structure that may not replicate within larger samples. Third, male and female participants

differed in age of onset. While this is consistent with the literature, we cannot say for certain that differences in age of onset or the slight but not significant difference in duration of illness did not impact our results. Finally, this sample is comprised of unmedicated inpatients which could limit the generalizability of the results. Given these limitations, future research should aim to replicate these findings with confirmatory factor analyses (CFA) within larger samples of equal numbers of males and females. Additionally, CFA should be conducted on medicated inpatients and outpatients to investigate the clinical utility of using this factor structure for research in medicated patients.

The results of this study support sex differences in the factor structure of the PANSS that may have contributed, at least in part, to prior conflicting factor analytic studies. The implications of the findings, if replicated, may be that separate male and female treatment research is necessary to find optimal sex-specific treatments for schizophrenia. These findings may have particular relevance for clinical trials, which often use the PANSS as an outcome measure, as treatment effects may be mitigated in females if scales that more accurately capture male symptomatology are used. The implication of these findings may also extend beyond treatment studies, as understanding sex-specific symptomatology may enhance our understanding of the neurobiological underpinnings of the disease as well as risk and protective factors. Future research should account for sex differences when examining the effects of treatments for schizophrenia, as well as investigating etiology and evaluating other factors affecting course and outcome within the disease.

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