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Changes in Academic and Social Premorbid Adjustment across Sex and Developmental Period in Individuals with Schizophrenia

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Abstract

The assessment of premorbid adjustment in schizophrenia has received considerable attention because of models suggesting that schizophrenia is a neurodevelopmental disorder characterized by abnormalities in functioning prior to onset of the disorder. Some studies suggest that premorbid adjustment is best viewed as a multidimensional construct where different areas of functioning might be differentially impacted by the illness and sex. The current study examined these matters using of Premorbid Adjustment Scale (PAS) in a sample of 421 individuals with schizophrenia. Confirmatory factory analyses conducted for three developmental periods (childhood, early adolescence, late adolescence) and for males and females separately, indicated that the PAS consists of academic and social factors that are invariant across developmental period and sex. Differences in severity of academic and social premorbid impairment were also present between males and females across developmental periods. Findings suggest important differences between males and females in the course of premorbid deterioration prior to onset of schizophrenia.

Keywords

Schizophrenia; Premorbid Adjustment Scale; Social; Academic; Neurodevelopmental

1.0. Introduction

Deficits in premorbid adjustment support neurodevelopmental models of schizophrenia (Murray et al., 1992; Weinberger, 1995). There is now strong evidence in schizophrenia of premorbid abnormalities in motor and intellectual abilities (Caspi et al., 2003; Marcus et al., 1993; Rosso et al., 2000; Schiffman et al., 2004, 2009; Walker, 1994; Walker et al., 1996), affective responsivity (Walker et al., 1996), and social and academic adjustment (Allen et al., 2001, 2005; Monte et al., 2008; Reichenberg et al., 2002; Schiffman et al., 2004; Strauss et al., 2012). Poor premorbid adjustment has been linked to a number of negative outcomes such as increased negative symptoms, worse global and cognitive functioning, poor psychomotor abilities, and decreased quality of life (MacBeth & Gumley, 2008; Malla & Payne, 2005). However, a relevant question is whether premorbid abnormalities are best characterized as a generalized deficit that equally affects many different premorbid abilities,

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or if there is evidence for multiple premorbid dimensions that show differences in severity and course of deterioration prior to schizophrenia onset, and demonstrate different patterns of association with relevant outcomes. Studies of the Premorbid Adjustment Scale (PAS; Cannon-Spoor et al., 1982) provide some support for this latter point of view by providing factor analytic evidence for separate social and academic functioning domains (Allen et al., 2001; Cannon et al., 1997; van Kammen et al., 1994) and demonstrating that these domains are differentially associated with a number of important outcomes after diagnosis of schizophrenia. For example, higher levels of academic adjustment in childhood are associated with more education, more work and better working memory, while a stable course of social adjustment was related to shorter duration of untreated psychosis, more friends, and fewer negative symptoms in adulthood (Larsen et al., 2004). There is also evidence that a differential decline in academic relative to social functioning occurs as the onset of psychosis approaches (Allen et al., 2005; Monte et al., 2008), and that this decline may be more pronounced in males than females (Monte et al., 2008). Individuals who meet criteria for “deficit schizophrenia” (i.e., primary and enduring negative symptoms; Carpenter et al., 1988; Kirkpatrick et al., 2001) show poorer overall premorbid adjustment (Buchanan et al., 1990), as well as more severe deterioration in social functioning compared to those with “nondeficit schizophrenia” (Strauss et al., 2012). Thus, prior research supports the validity of distinct but related academic and social dimensions of premorbid functioning in schizophrenia. However, a review has highlighted the lack of studies examining academic and social premorbid adjustment separately and stressed the importance of increasing this type of investigation (MacBeth & Gumley, 2008).

In the current study, we aimed to extend the literature on premorbid adjustment by addressing a number of unresolved questions regarding the stability of the latent structure of the PAS across developmental periods and sex, and by examining differences between males and females on the PAS factors. Regarding latent structure, prior studies have examined the factor structure of the PAS by collapsing across items from the childhood, early adolescence, and late adolescence developmental periods, even though stability of the PAS factor structure across developmental periods cannot be assumed, given the evidence for differences in rate of premorbid decline across developmental periods. Also, although there are well-documented sex differences in premorbid decline, which generally indicate better functioning in females with schizophrenia, there is some evidence that these differences are not uniformly reflected across all of the premorbid domains subscales (Childers and Harding 1990; Gittelman-Klein and Klein 1969; Hoff et al. 1998; Larsen et al. 1996; however, see Schmael et al., 2007). Therefore, the current study evaluated stability of the PAS factor structure across each of the three developmental periods (childhood, early adolescence, late adolescence) in males and females, and further compared developmentally related changes in academic and social functioning for males and females. Based upon previous factor analytic studies of the PAS (Allen et al., 2001; Cannon et al., 1997; van Kammen et al., 1994), we hypothesized that a model consisting of academic and social factors would provide the best fit of the data at each developmental period for both males and females, and that there would be sex related differences in social and academic developmental trajectories that generally favored females.

2.0. Methods

2.1. Participants

Participants included 421 adults (male = 284, female = 137) who met DSM criteria for schizophrenia ($n = 382$) or schizoaffective disorder ($n = 39$). There were 257 outpatients and 164 inpatients recruited through the research programs at the Maryland Psychiatric Research Center (MPRC). Demographic and clinical characteristics are presented in Table 1 for the entire sample, and for males and females separately. One-way ANOVAs and chi square

analyses comparing the males and females indicated that the groups did not significantly differ on race, inpatient/outpatient status, or schizophrenia/schizoaffective diagnosis. Males were significantly younger than females at the time of the evaluation, had an earlier age of onset, fewer years of education, and poorer premorbid adjustment overall and for every developmental period.

Schizophrenia onset was operationally defined as the first time at which full criteria for schizophrenia were met according to the DSM that was in use at the time of the evaluation. The presence of symptoms meeting criteria for schizophrenia was established using the Structured Clinical Interview for DSM diagnoses (SCID). For this study, only individuals whose prodrome or illness onset occurred entirely in the adult period (age 19 or after) were included. Prodrome was operationally defined as presence of symptoms that met criteria for one of the Criteria A symptoms for schizophrenia as established by the SCID. We did not include data collected for the adulthood period because the PAS items differ from the earlier developmental periods, and because many participants were already in the prodromal phase of the illness by early adulthood. Finally, only individuals with complete data for each developmental period were included.

2.2. Measures

The PAS is widely used to assess premorbid functioning in schizophrenia and other disorders and has excellent psychometric properties (Allen et al., 2001; Alvarez et al., 1987; Brill et al., 2008; Cannon-Spoor et al., 1982; Krauss et al., 1998). The PAS was designed to assess premorbid functioning across developmental periods and across a number of domains. The developmental periods include childhood (up to 11 years), early adolescence (12 to 15 years), late adolescence (16 to 18 years), and adulthood (19 years and above). PAS items to assess premorbid domains from childhood to late adolescence include 1) sociability and withdrawal, 2) peer relationships, 3) scholastic performance, 4) adaptation to school, and 5) social-sexual functioning (social-sexual functioning is not assessed during childhood). Each domain is rated on a 0 to 6 point scale, with 0 indicating normal adjustment and 6 indicating severe impairment. The “premorbid” period for PAS purposes is the period ending six months prior to the first episode.

The PAS was completed by raters trained to reliably administer and score the instrument based on standardized procedures. This included a semi-structured interview completed with participants and their family members to gain information pertaining to the premorbid period (Cannon-Spoor et al., 1982). Family members selected for the interview were determined to be reliable informants on the basis of having substantial contact with the participant during childhood, adolescence, and early adulthood. In addition, collateral information was also obtained from hospital and academic records when available. This extensive background information collected on these participants was necessary to ensure accurate completion of the PAS because many of the participants had been diagnosed with schizophrenia for many years at the time of the current evaluation.

2.3. Procedure

The Premorbid Adjustment Scale (PAS; Cannon-Spoor et al., 1982) was administered as part of a battery of measures that were given to participants on their index admission into the MPRC, from the years 1988 to 2010. In addition to the PAS, this battery included demographic and clinical history interviews, a family history interview, the Structured Clinical Interview for DSM, symptom interviews, neuropsychological tests, and functional outcome measures.

2.4. Data Analysis

Confirmatory factor analyses were conducted using EQS (Bentler, 2004). Four goodness-of-fit statistics were used to determine the adequacy of fit for the models, including the maximum-likelihood chi-square test, comparative fit index (CFI; Bentler, 1990), root mean square error of approximation (RMSEA; Steiger & Lind, 1980), and Akaike information criterion (AIC; Akaike, 1987). These indexes were selected because they examine several different and important aspects of model fit (Byrne, 2006; Kline, 2005). A significant chi-square provides an indication of poor fit between the hypothesized model and the sample data. The CFI is an incremental fit index that ranges from 0 to 1 and indicates relative fit of the model as compared to the baseline independence model, with values greater than .95 indicating good fit (Hu & Bentler, 1999). The RMSEA ranges from 0 to 1 and is considered a parsimony index because it also takes into account model complexity, with a good fit indicated by a value of 0.05 or less (Jöreskog & Sörbom, 1993). The AIC is a predictive fit index because it estimates how well the model would fit in a hypothetical replication sample. The AIC is not scaled between 0 and 1, so interpretation of AIC is entirely comparative, with a smaller AIC indicating better fit.

Because maximum likelihood methods require multivariate normality, we used Mardia's statistic (1970) to evaluate whether this assumption was met. In cases where Mardia's statistic was greater than 3.0, robust statistics were used (Bentler, 2004). Additionally, we checked for the presence of outliers by examining the five cases that made the greatest contribution to Mardia's statistic, as recommended by Bentler (2004). There was no evidence of outliers in this data.

Two CFA models were examined. The first model was based on a conceptualization of premorbid functioning as a unitary construct best represented on the PAS by one general premorbid adjustment summary score. This one-factor model specified that at each developmental level (childhood, early adolescence, late adolescence), the five PAS items would all load on a single factor. This model was designated PAS₁₂₃₄₅ for early and late adolescence and PAS₁₂₃₄ for childhood (where the social-sexual functioning item is not rated). The second model is based on studies suggesting that PAS scores are better conceptualized as measuring two separate but related factors that reflect social and academic premorbid adjustment (Allen et al., 2001; Cannon et al., 1997; van Kammen et al., 1994). For this model, PAS items 1, 2 and 5 (sociability and withdrawal, peer relationships, and social-sexual) were specified to load on a Social premorbid adjustment factor, while PAS items 3 and 4 (scholastic performance and adaptation to school) were specified to load on an Academic premorbid adjustment factor. This model was designated SO₁₂₅AC₃₄ for early and late adolescence and SO₁₂AC₃₄ for childhood.

After the best fitting model for each combination of sex and developmental period had been determined, a series of two-group models were fit to determine whether the factor structure was the same for males and females. In each analysis, the factor loadings and the correlation between factors were set to be equal for males and females. If this model fits the data, it indicates that a single model for males and females fits the data just as well as separate models, and the factor structure can be considered identical across the two sexes.

Finally, given potential premorbid differences between males and females across developmental periods and premorbid domain, we used a mixed-model ANOVA to compare the males and females on the social and academic domains across the three developmental periods. The domain scores should provide a more reliable indication of function than single items.

3.0. Results

3.1. CFA Results

Goodness-of-fit indices for the CFA models at each developmental period for males and females are presented in Table 2. As hypothesized, the two-factor model provided a better fit of the data than the one-factor model at each developmental level for both males and females. At each developmental period and for each sex, the one-factor model yielded significant chi-squares, and the CFI and RMSEA indicated marginal to poor fit. In contrast, the two-factor models consistently yielded non-significant chi-squares, and the CFI and RMSEA indicated moderate to excellent fit. Moreover, the AICs were consistently smaller for the two-factor models than the one-factor models. Thus, the two-factor model was selected as the best model for each sex and for each developmental level.

Multigroup analyses of the two-factor models were conducted for males and females at each developmental period (see Table 3). All of these multi-group models fit the data well indicating that at all ages, the structure of the test is comparable for males and females. Males and females were therefore combined into a single analysis at each age level and the factor loadings and inter-factor correlations were very similar to the previous multi-group analysis and are presented in Figure 1. As can be seen from the figure, all of the PAS items had strong loadings on their respective factors at each of the three age levels.

3.2. Sex Differences across PAS domains and Developmental Levels

To examine sex differences in academic and social PAS scores (Monte et al., 2008), we conducted a Sex (Male, Female) X developmental period (childhood, early adolescence, late adolescence) X PAS domain (social, academic) mixed-models ANOVA. There were significant main effects for sex, developmental period, and PAS domain (p 's < .001), as well as significant interactions for developmental period X sex, $F(2,418)=10.27$, $p<.0001$, $\eta^2=.047$, and developmental period X PAS domain, $F(2,418)=10.36$, $p<.0001$, $\eta^2=.047$. As can be seen in Figure 2, interaction effects reflect that females had better premorbid adjustment than males for both Social and Academic adjustment but unlike males, did not demonstrate a steep decline in premorbid social adjustment from childhood to late adolescence. However, both groups demonstrated poorer academic compared to social adjustment by late adolescence, suggesting that decline in academic premorbid function is a consistent indicator of schizophrenia that is unaffected by sex.

4.0. Discussion

Results of this study extend prior research in several important ways by finding that the PAS social and academic factors are the same in males and females, and remain stable across childhood, early adolescence, and late adolescence developmental periods. Given the stability of these dimensions across developmental periods, the use of scores reflecting social and academic adjustment is preferred over the use of a general score that averages across the PAS items or the scores from individual items. Outside of these methodological considerations, identification of the two distinct domains may have important theoretical implications. A number of studies interested in the heterogeneity of schizophrenia have used premorbid adjustment scores to develop classification schemes (Haas & Sweeney, 1992; Cole et al., 2012). These studies are particularly relevant to the current results because they used PAS scores averaged across social and academic items. Both studies identified three subtypes that could be characterized as good adjustment, declining adjustment, and poor adjustment. The good adjustment group evidenced good academic and social adjustment prior to onset, the declining adjustment group had good adjustment in childhood but demonstrated decline in functioning as onset of the disorder approached, and the poor group had poor adjustment in childhood, which remained stable, or declined further as onset

approached. Both studies report that good premorbid adjustment was associated with more positive outcomes while poor premorbid adjustment was associated with increased negative outcomes. However, neither study considered the distinction between the academic and social domains. Whether considering academic and social adjustment separately within a subtyping system would provide more meaningful subtypes awaits further investigation, as do the environmental and biological developmental influences that cause the differences in trajectory across these two domains.

We also found that males exhibit more severe premorbid impairment than females, and that the decline of academic adjustment is evident in both sexes. Interestingly, females did not demonstrate any meaningful decline in social functioning from childhood to late adolescence, in contrast to academic functioning, which did decline. Sparing of social functioning in females may be linked to neuroprotective effects of estrogen which is associated with older age of onset, milder negative symptoms, and better response to antipsychotics (Pregeli, 2009; Häfner 2003; Kulkarni, Gavrilidis, Hayes, Heaton, Worsley, 2012). Consistent with this suggestion, Strauss et al. (2012) reported poorer premorbid social adjustment in those with primary persisting negative symptoms, which also occur at higher rates among males. These findings also parallel sex differences in functional outcome and recovery that occur much later in life among individuals with schizophrenia (Grossman et al., 2008). It may be that some of the contradictory findings regarding relationships between sex and premorbid adjustment (for review see Schmael et al., 2007) can be accounted for by a failure to consider academic and social domains separately.

Deterioration in premorbid academic functioning may be a unique neurodevelopmental marker for schizophrenia and a number of studies also suggest that deterioration accelerates from early adolescence to late adolescence (Allen et al., 2005; Fuller et al., 2002; Gunnell et al., 2002; Jones et al., 1994; Monte et al., 2008; van Oel et al., 2002). The current results comparing academic functioning to social functioning extend this research by revealing that accelerated deterioration in premorbid academic functioning from childhood to late adolescence is evident for both males and females, although males demonstrate an overall greater deficit in this domain.

The current study had a number of limitations, including the use of retrospective interviews and chart reviews to establish premorbid functioning. This limitation is mitigated to some extent by studies demonstrating robust correlations between the PAS scores and, for example, draft board scores obtained before schizophrenia onset (e.g., Brill et al., 2008). Despite this limitation, the current results suggest that premorbid adjustment should be viewed as multidimensional in nature consisting of at least two domains (academic and social), and that the developmental trajectory of these domains are differentially affected in males and females. Future studies may further investigate the multidimensional nature of premorbid adjustment by using multiple methods and instruments capable of assessing the multi-faceted abnormalities known to occur during the premorbid phase of schizophrenia (e.g., affective and motor dysfunction).

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Figure 1. Best Fitting Models at Each of the Three Developmental Levels

Note. In confirmatory factor analyses, rectangles represent measured variables (in this case, the PAS items), while circles represent latent constructs. This model includes two types of latent constructs: the factors (Academic Adjustment, Social Adjustment) and the random error components (E).

Figure 2.
Changes in Social and Academic Adjustment across Developmental Levels for Males and Females

Table 1

Demographic and Clinical Characteristics for Females, Males and the Entire Sample.

	Female (n=137)		Male (n=284)		Total (n=421)		F	df	p
	Mean	sd	Mean	sd	Mean	SD			
Age	40.8	9.0	35.4	9.1	37.2	9.4	32.17	1, 418	<.001
Age Onset	26.3	7.1	23.8	5.3	24.6	6.1	16.46	1, 419	<.001
Education *	12.9	2.0	12.6	2.0	12.7	2.0	3.39	1, 411	.07
PAS Childhood	1.73	1.03	1.98	1.07	1.90	1.06	5.07	1, 419	.03
PAS Early Adolescence	1.82	1.00	2.22	1.07	2.09	1.06	13.22	1, 419	<.001
PAS Late Adolescence	1.92	1.12	2.60	1.22	2.38	1.23	30.02	1, 419	<.001
PAS Total	1.84	0.94	2.30	1.00	2.15	1.01	20.10	1, 419	<.001
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	%		%		%		χ^2	df	P
Race							0.817	2	.67
White	51.1		54.9		53.7				
African American	42.3		40.1		40.9				
Other	6.6		4.9		5.5				
Treatment Program							2.00	1	.16
Inpatient	43.8		36.6		39.0				
Outpatient	56.2		63.4		61.0				
Diagnosis							0.012	1	.91
Schizophrenia	90.5		90.8		90.7				
Schizoaffective	9.5		9.2		9.3				

* Total N = 413, Females = 135, Males = 278.

Table 2
Goodness of Fit Indices for All Models at Each Developmental Level for Males and Females

Developmental Period	Sex	Model	Fit Indices						
			χ^2	df	p	CFI	RMSEA	[90% CI]	AIC
Childhood	Male	PAS ₁₂₃₄	70.71	2	.00	.82	.348	[.280, .418]	66.71
		SO ₁₂ AC ₃₄	0.30	1	.59	1.00	.000	[.000, .125]	-1.71
	Female	PAS ₁₂₃₄	10.28	2	.01	.94	.175	[.080, .286]	6.28
		SO ₁₂ AC ₃₄	0.12	1	.73	1.00	.000	[.000, .160]	-1.88
Early Adolescent	Male	PAS ₁₂₃₄₅	116.17	5	.00	.80	.280	[.236, .326]	106.13
		SO ₁₂₅ AC ₃₄	5.65	4	.23	1.00	.038	[.000, .104]	-2.35
	Female	PAS ₁₂₃₄₅	33.90	5	.00	.85	.207	[.144, .274]	23.90
		SO ₁₂₅ AC ₃₄	3.88	4	.42	1.00	.000	[.000, .128]	-4.12
Late Adolescent	Male	PAS ₁₂₃₄₅	171.07	5	.00	.73	.343	[.299, .386]	161.07
		SO ₁₂₅ AC ₃₄	3.39	4	.50	1.00	.000	[.000, .083]	-4.61
	Female	PAS ₁₂₃₄₅	54.12	5	.00	.78	.270	[.206, .334]	44.12
		SO ₁₂₅ AC ₃₄	6.74	4	.11	.99	.071	[.000, .161]	-1.26

Note. CFI = comparative fit index; RMSEA = Root mean square error of approximation; CI = Confidence interval; AIC = Akaike information criterion; PAS₁₂₃₄ and PAS₁₂₃₄₅ = One-factor model; SO₁₂AC₃₄ and SO₁₂₅AC₃₄ = Two-factor model based with on results from the CTMT Normative Sample.

¹ Robust statistics are reported for females because Mardia's statistic was 3.88, indicating lack of normality.

Table 3

Goodness of Fit Indices for Multi-Sample Analyses at Each Developmental Level

Developmental Period	Model	Fit Indexes					
		χ^2	df	p	CFI	RMSEA	[90% CI]
Childhood ¹	SO ₁₂ AC ₃₄	9.98	7	.79	.99	.045	[.000, .103]
Early Adolescence ²	SO ₁₂₅ AC ₃₄	17.95	14	.21	1.00	.037	[.000, .080]
Late Adolescence ³	SO ₁₂₅ AC ₃₄	18.28	14	.17	1.00	.038	[.000, .081]

Note. CFI = comparative fit index; RMSEA = Root mean square error of approximation; CI = Confidence interval; AIC = Akaike information criterion. SO₁₂AC₃₄ and SO₁₂₅AC₃₄ = Two-factor model based with on results from the CTMT Normative Sample.

¹ Chi-square for independence model = 530.85; df = 12.

² Chi-square for independence model = 755.98; df = 20.

³ Chi-square for independence model = 815.625; df = 20. Robust statistics are reported because Mardia's statistic was 3.84 in females, indicating lack of normality.