Assessment of intelligence with Raven and WAIS in patients with psychosis

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Abstract

The Wechsler Adult Intelligence Scale (WAIS) is considered the most reliable and commonly used intelligence test. However, in some cases WAIS it is difficult to administer to clinical populations such as patients with psychosis. The Raven Progressive Matrices (RPM) is an intelligence test which is substantially shorter than the WAIS and its administration is less demanding and stressful for patients with psychosis who display neurocognitive impairments. Furthermore, RPM offers high reliability and validity, while it can be administered individually or in groups, can be re-administered after a short period of time, can be given to subjects independently of educational level, even to those presenting verbal or auditory difficulties, producing results compatible to other more strenuous IQ tests.

The aim of the present study was to investigate whether there is an association between WAIS Full Scale IQ and RPM in patients with psychosis. Furthermore, we wanted to examine whether there is an association between WAIS-IQ scores, RPM scores, global functioning and psychopathology scores. Patients were recruited from the Vocational Rehabilitation Center of Eginition Hospital, University of Athens Medical School, between January 2010 and December 2013. The sample consisted of 59 male and female patients with psychosis, between 25-59 years of age. The patients followed a psychosocial rehabilitation program, the main goals of which was improvement of quality of life, decrease of negative psychotic symptoms and improvement of general functioning. The program encompasses a series of psychosocial individual and group interventions including psycho-educational interventions to patients and their families, Cognitive Behavioral Therapy (CBT) and social skills training. All subjects were provided with detailed written information about the nature and purpose of the study and gave written informed consent to participate. A stable antipsychotic regimen was

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an inclusion requirement. The following psychometric instruments were administered to all participants: WAIS, RPM, the Mini-International Neuropsychiatric Interview (MINI), the Diagnostic Interview for Psychoses (DIP), the Global Assessment of Functioning Scale (GAF) and the Positive and Negative Syndrome Scale (PANSS). A significant correlation was found between WAIS and RPM scores. Furthermore, WAIS-and RPM scores were found to be significantly associated with GAF and PANSS scores. These findings demonstrate that RPM is a useful intelligence test with a handful of advantages for the patient with psychosis, the clinician and the health system.

Key Words: WAIS intelligence test, Raven Progressive Matrices test, psychosis, schizophrenia, schizoaffective disorder, bipolar disorder

Introduction

The Wechsler Adult Intelligence Scale (WAIS) is considered the most reliable and commonly used intelligence test[1-3]. However in some cases, WAIS is difficult to use with clinical populations such as patients with psychosis, due to long time needed for administration[4].

Psychosis is one of the ten most important causes of long term disability worldwide [5,6]. Patients with psychosis suffer from: a. positive symptoms (delusions, hallucinations); b.negative symptoms (encompassing volition disturbances, poverty of speech and social withdrawal); c. cognitive impairment (memory, attention and executive function deficits). Consequently, it is often difficult to administer a lengthy intelligence test such as the WAIS to patients with psychosis. Therefore, there is a need for shorter, more "user friendly" intelligence tests for these patients. Raven Progressives Matrices (RPM) addresses this need, being an intelligence test that can be given to individuals of different socio-cultural backgrounds without significant errors attributable to the influence of cultural factors[4,7,8]. The RPM has been described not as an IQ test, but rather as a reflection of thought patterns [8,9].

O'Leary et al.[10] conducted a study including 308 in-patients and outpatients of a psychiatric hospital, with various diagnoses ranging from chronic schizophrenia to organic brain syndrome and personality disorders. A significant positive correlation was found between age-stratified WAIS-R Full Scale IQ and SPM in all age groups except older patients (65 and over); and between educational level and SPM for all age groups except the very young (16 to 24 years) and those over 55 years of age. Within this context, we investigated whether there is a similar association between WAIS and SPM scores specifically in patients with psychosis. Furthermore, we examined whether there is an association between WAIS-IQ scores, SPM scores, GAF scores and PANSS psychopathology scores.

Material and method

Sample

The study was approved by the Eginition University Hospital Research Ethics committee and is consistent with the Declaration of Helsinki. Patients were recruited from the Vocational Rehabilitation Center of Eginition Hospital, University of Athens Medical School, between January 2010 and December 2013. The sample consisted of 59 male and female patients with psychosis, between 25-59 years of age (mean 42.9, SD±8.9). 80% of the sample was diagnosed with schizophrenia, 15% with bipolar disorder, and 5% with schizoaffective disorder. Diagnoses were confirmed using the Mini-International Neuropsychiatric Interview (MINI)[11, 12] and the Diagnostic Interview for Psychoses (DIP)[13, 14].

All subjects were provided with detailed written information about the nature and purpose of the study and gave written informed consent to participate. A stable antipsychotic regimen was an inclusion requirement. Most patients had decreased levels of positive psychotic symptoms (hallucinations, delusions etc.) and increased levels of negative psychotic symptoms (social isolation and withdrawal etc.). They followed a psychosocial rehabilitation program, the main goals of which was improvement of quality of life, decrease of negative psychotic symptoms and improvement of general functioning. The program encompasses a series of psychosocial individual and group interventions including psycho-educational interventions to patients and their families, Cognitive Behavioral Therapy (CBT) and social skills training[13, 14].

Outcome Measures

The following psychometric instruments were administered to all the subjects: Wechsler Adult Intelligence Scale (WAIS), Raven Progressive Matrices (RPM), Global Assessment of Functioning Scale (GAF), Positive and Negative Syndrome Scale (PANSS). Intelligence was assessed by means of WAIS and RPM.

The WAIS is an intelligence test first published in 1955, designed to measure intelligence in adults and older adolescents. Wechsler's scale is based on his definition of intelligence as "... the global capacity of a person to act purposefully, to think rationally, and to deal effectively with his environment."[17]. He believed that general intelligence is composed of various specific and interrelated functions or elements that can be individually measured[18]. The WAIS therefore consists of six verbal and five performance subtests. The verbal tests include Information, Comprehension, Arithmetic, Digit Span, Similarities and Vocabulary; the Performance subtests are Picture Arrangement, Picture Completion, Block Design, Object Assembly and Digit Symbol. The scores derived from the WAIS are Verbal IQ (VIQ), a Performance IQ (PIQ) and Full Scale IQ (FSIQ). The FSIQ is a standard score with a mean of 100 and a standard deviation of 15. Lower scores on verbal IQ are common in subjects of lower socio-economic status and subjects that encounter difficulties on speaking and comprehending the test language[2, 18]. Lower scores on performance IQ are typical of patients with chronic psychosis with impairments in their cognitive functions [2, 18, 19].

The RPM is the most common and popular nonverbal intelligence test administered to groups ranging from 5-year-olds to the elderly[8, 20].The test was originally developed by John C. Raven in 1936. It includes 60 multiple choice items listed in ascending order of difficulty. [8, 20] For each test item, the subject is asked to identify the missing element that completes a pattern. Patterns are presented in the form of 4x4, 3x3, or 2x2 matrices, hence the name of the test. The matrices are available in three different forms for participants of different ability:

• Standard Progressive Matrices (the form used in this study): This was the original form of the matrices, first published in 1938. The booklet comprises five sets (A to E) of 12 items each (e.g., A1 through A12), with items within a set becoming increasingly difficult, requiring progressively greater cognitive capacity to encode and analyze information. All items are presented in black ink on a white background.

• Alternative forms include the Coloured Progressive Matrices and the Advanced Progressive Matrices.

The fundamental advantage of the RPM compared to other intelligence tests is that it can be given to individuals of different socio-cultural background without significant errors attributable to the influence of cultural

factors. Furthermore, it can be administered to illiterate or speech- and hearing-impaired individuals, since oral instructions are kept to a minimum. However, RAVEN-type tests are not typical I.Q. tests, but rather tests which selectively explore specific kinds of intelligence such as the testee's analytic ability, together with visual sense and sense of symmetry, as well as the ability to detect relationships between shapes and symbols.

The Positive and Negative Syndrome Scale (PANSS)[21,22] and the Global Assessment of Functioning (GAF) Scale[23-25] were used to evaluate psychotic symptoms and functioning, respectively.

The 30-item PANSS[21,22] was conceived as an operationalized, drug-sensitive instrument that evaluates positive and negative symptoms. Of the 30 items included in the PANSS, 7 constitute the Positive Symptom Scale (POS), 7 the Negative Symptom Scale (NEG) and the remaining 16 the General Psychopathology Symptom Scale (GEN). The scores for these scales are derived from the summation of ratings across component items. Therefore, the potential ranges are 7 to 49 for the Positive and Negative Scales, 16 to 112 for the General Psychopathology Scale and 30 to 210 for the PANSS Total score.

The Global Assessment of Functioning (GAF)[23-25] is a numeric scale (1 - 100) used by mental health clinicians to rate the social, occupational, and psychological functioning of adults.

Procedure

Administration of all scales and psychometric instruments began one month after the entry of each patient in the program and was spread over about 4-5 weeks in order to minimize patient fatigue and resistance. The psychometric instruments of WAIS and RPM were administered and graded by a trained psychologist. A psychiatrist administered the MINI, the DIP, the GAF and the PANSS scales.

Statistical Analysis

All analyses were performed with the aid of the Statistical Package for Social Sciences (SPSS). In terms of descriptive statistics, frequencies were used for categorical variables and means and standard deviations for continuous variables. For exploring associations between variables, the non parametric Spearman Correlation test was used. Additionally, we conducted descriptive analysis of all the demographic and clinical characteristics of the sample and correlation between the sample and aforementioned factors.

Results

Sample characteristics (table 1)

Most of the subjects were male and single (73% males and 27% females). The mean age of participants was 42.9 years (±8.9). 57% of participants had up to 12 years of education, the remaining 43% over 12 education years. 90% of the sample has been hospitalized at least once and up to 4 times (table 1). The mean illness duration was approximately 22 years (±8.3). It must be noted that the relationship between illness duration / number of hospitalizations with psychopathology / functioning level was not significant. However, the chronicity of our patients' psychosis may have obscured the detection of these associations.

The mean IQ WAIS FULL SCALE score was 91.4 (±13.9) (range 68-128), while the mean GAF score was 43.3 (±9.3; range 30-68). The mean RPM score was 33 (±11.5; range 1-54). The mean PANSS Total score was 114.5 (±31.2; range 37-164). The mean PANSS POS score was 23.2 (±8; range 7-38), the mean NEG score was 32.6 (±9; range 7-50) and the GEN score was 114.5 (±31.2; range 37-164).

Correlations between WAIS FULL IQ and RPM, GAF and PANSS (table 2).

Regarding our main hypothesis, a strong correlation was detected between the WAIS IQ FULL score and the RPM score ($p<0.01$). Moreover there was a correlation between RPM scores and WAIS performance IQ scores (PIQ) ($p<0.001$), while there was a less significant association of RPM scores and verbal IQ (VIQ) scores ($p<0.05$).

The WAIS IQ FULL score was significantly correlated with the GAF score ($p<0.01$). Moreover, the WAIS IQ FULL score had a significant negative correlation with all the PANSS subscales ($p<0.01$: table 2, 3).

The RPM score was significantly correlated with the GAF score ($p<0.01$), as well as with the general psychopathology PANSS subscale ($p<0.05$) (table 4).

The GAF score was significantly correlated with both the WAIS IQ FULL score and the RPM score, while it there was a significant negative correlation between GAF and all the PANSS subscales, particularly with the PANSS Negative Subscale (table 2, 3).

As expected, we found that the higher the education level of a participant, the higher the GAF score was. In addition, the years of education were significantly correlated both with the WAIS FULL IQ score and the RPM score (table 4).

Discussion

This was the first time that an association between WAIS and RPM scores was investigated specifically in patients with psychosis. The significant correlation of WAIS IQ FULL score with the RPM score in patients with psychosis is an important finding, in line with previous results showing a corresponding correlation in subjects without psychosis[10,26]. The significant correlation between the two tests supports the wider use of RPM in psychosis. This is a significant conclusion, given that the RPM offers several practical advantages compared to the WAIS.

From the point of view of psychometric profile, the RPM offers high reliability and validity, producing results compatible to those of other, more strenuous IQ tests[27-30]. Furthermore it can be re-administered after a short period of time since there is no significant statistical change of mean values between repeated administrations[8,9].

With respect to practical advantages, the RPM is substantially shorter than the WAIS[27,28,31]. Its administration is less demanding and stressful, as it evaluates a subject's ability to make comparisons and produce syllogisms based on analogies[8,31]. It is therefore particularly appropriate for patients with psychosis who display neurocognitive impairments across most cognitive domains[32-35].

Further advantages are that it can be given to subjects independently of educational level, even to those presenting verbal or auditory difficulties, since verbal instructions are limited to a minimum[26,36,37]. Also, it can be administered individually or in groups without any impact on its validity and reliability[27,31,38].

As expected, we found that higher intelligence scores (IQ) were associated with better general functioning (GAF scores), as was education level (table 4). This positive correlation was significant both for the WAIS and for the RPM, although the association appeared to be closer between WAIS and GAF scores (table 2). These observations are in line with previous findings showing that IQ reflects level of adjustment and efficiency in everyday activities and conditions[39].

A statistically significant negative correlation[40] was found between IQ WAIS FULL score and decreased PANSS negative symptoms in psychotic patients. Taken as a whole, these findings show that, for patients with psychosis, the higher the IQ (WAIS FULL score)[41] the lower the negative symptoms[42,43] and the higher the level of general functioning (GAF levels)[42,44,45]. It is widely known that high stress levels are associated with probability of relapses of psychosis[6,46,47]. Therefore a higher IQ WAIS FULL score and the corresponding increased ability to process everyday life by encoded and analytic thinking may lead to higher functioning levels[48] and better condition adjustment. This may result in reduced levels of stress and reduced risk of relapse.

Shorter versions of WAIS have been used in patients with psychosis[49,50].

Subtests like the Blyler[51] and the Satz-Mogel short forms[52-54] are considerably shorter alternatives of the full-scale WAIS, yet administration time lasts approximately 45 minutes, which can sometimes be too time consuming. Yet, a new 15-minute version of the WAIS-III proposed by Velthorst et al., (2013)[50] gave reliable estimates of the Full Scale IQ (FSIQ) in patients diagnosed with schizophrenia, their siblings without schizophrenia and unrelated healthy controls. Both this 15-minute version of the WAIS and RPM may be especially recommended for those desiring maximal information on cognitive impairment when time constraints apply.

Conclusion

A significant correlation was found between WAIS and RPM scores in patients with psychosis. Furthermore, WAIS and RPM scores were found to be positively associated with GAF and negatively associated with PANSS scores. These findings demonstrate that Raven Progessive Matrices is a useful alternative to the WAIS, shorter and less strenuous in its administration, offering significant advantages for the patient with psychosis as well as economy in the resources of the health system.

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Tables

Table 1. Demographic Characteristics

	N	%
Gender		
Male	43	72,8
Female	16	27,2
Education Status		
<12 years	18	30,5
12 years	16	27,1
>12 years	25	42,4
Marital Status		
Single	53	90
Married	3	5
Seperated	3	5
Number of hospitalizations		
0	7	11,9
1	14	23,7
2	14	23,7
3	8	13,6
4+	16	27,1

Table 2: Main correlations

		IQ WAIS FULL SCALE	RAVEN ALL	GAF	PANSS POS	PANSS NEG	PANSS GEN	PANSS ALL
Spearman's rho	**IQ WAIS FULL SCALE** Correlation Coefficient	1,000	,352**	,648**	-,357**	-,510**	-,405**	-,426**
	Sig. (2-tailed)	.	,006	,000	,006	,000	,001	,001
	N	59	59	59	59	59	59	59
	RAVEN ALL Correlation Coefficient	,352**	1,000	,320**	-,200	-,224	-,259*	-,243
	Sig. (2-tailed)	,006	.	,010	,114	,075	,038	,053
	N	59	59	59	59	59	59	59
	GAF Correlation Coefficient	,648**	,320**	1,000	-,692**	-,813**	-,662**	-,752**
	Sig. (2-tailed)	,000	,010	.	,000	,000	,000	,000
	N	59	59	59	59	59	59	59
	PANSS POS Correlation Coefficient	-,357**	-,200	-,692**	1,000	,725**	,867**	,937**
	Sig. (2-tailed)	,006	,114	,000	.	,000	,000	,000
	N	59	59	59	59	59	59	59
	PANSS NEG Correlation Coefficient	-,510**	-,224	-,813**	,725**	1,000	,701**	,838**
	Sig. (2-tailed)	,000	,075	,000	,000	.	,000	,000
	N	59	59	59	59	59	59	59
	PANSS GEN Correlation Coefficient	,405**	-,259*	-,662**	,867**	,701**	1,000	,957**
	Sig. (2-tailed)	,001	,038	,000	,000	,000	.	,000
	N	59	59	59	59	59	59	59

Tables

Table 3. Correlations of Full IQ with secondary parameters

IQ WAIS FULL SCALE

	rho	p-value
RAVEN ALL	0,352	<0,001
GAF	0,648	<0,001
PANSS POS	-0,357	<0,001
PANSS NEG	-0,51	<0,001
PANSS GEN	-0,405	<0,001
PANSS ALL	-0,426	<0,001

Table 4.Correlation of education with parameters

Education Status

	rho	p-value
RAVEN ALL	0,077	>0,05
GAF	0,307	<0,05
IQ WAIS FULL SCALE	0,377	<0,01