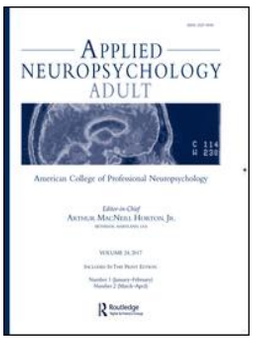

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The importance of clinical normative data for conceptualizing neuropsychological deficits in people with schizophrenia spectrum disorders

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ABSTRACT

Objective: To create clinical normative data tables for Norwegian patients with schizophrenia spectrum disorders, to examine whether clinical normative data from Norway differs from similar normative data from Canada and the U.S., and to illustrate the usefulness of such data.

Method: A nationally representative sample of 335 patients from psychiatric hospitals in Bergen, Norway was included. Inclusion criteria were 18–39 years of age, Norwegian as first language, and symptoms of schizophrenia, psychosis, or hallucinations. Comorbid substance abuse was recorded in 134 (40.0%). All completed the Norwegian version of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS).

Results: The average scores of patients with schizophrenia spectrum disorders were approximately one to two standard deviations below the mean for healthy adults. There were no significant differences in scores between patients with or without comorbid substance abuse. Men had higher scores than women. Clinical normative reference value look-up tables were created.

Conclusions: Clinical normative values were very similar to values from Canada and the U.S. Clinical normative data, as a supplement to standard healthy normative data, can be used to describe patients' cognitive performance in terms of expectation for their peer group which can be useful for multidisciplinary treatment planning.

KEYWORDS

Clinical norms; drug abuse; cross-cultural; RBANS; schizophrenia

Introduction

People with schizophrenia spectrum disorders usually experience cognitive impairments (Anda et al., 2016; Barder et al., 2013; Dickerson et al., 2004; Gogos, Joshua, & Rossell, 2010; Helle et al., 2014; Hobart, Goldberg, Bartko, & Gold, 1999; Iverson, Brooks, & Haley, 2009; Keefe, 2014; Øie, Sundet, & Ueland, 2011; Sponheim et al., 2010; Wilk et al., 2004; Zhang et al., 2012, 2018). On average, they perform one to two standard deviations below the general population on tests of attention (Holmen, Juuhl-Langseth, Thormodsen, Melle, & Rund, 2010), learning and memory (Barder et al., 2013; Egeland et al., 2003), processing speed (Schaefer, Giangrande, Weinberger, & Dickinson, 2013), and executive functioning (Reichenberg et al., 2010). Cognitive impairment in people with schizophrenia spectrum disorders is associated with worse outcomes, such as decreased quality of life, unemployment, poorer social functioning, and institutionalization (Lysaker, Bryson, Davis, & Bell, 2005; Øie et al., 2011; Rajji, Miranda, & Mulsant, 2014; Rosenheck et al., 2006; Savilla, Kettler, & Galletly, 2008; Vaskinn et al., 2008). The severity of cognitive impairment is somewhat correlated with disease duration (Barder et al., 2013; Keefe, 2014; Rajji et al., 2014; Sponheim et al., 2010; Zhang, Li et al., 2015) and disease severity (Barder et al., 2013; Galaverna, Morra, & Bueno, 2014; Simonsen et al., 2011).

Comorbid substance abuse is common among people with schizophrenia spectrum disorders. In Norway, the overall prevalence rate of substance abuse among patients with schizophrenia spectrum disorders is estimated to be 25–38% (Nesvåg et al., 2015; Ringen et al., 2007). The effect of substance abuse on cognition in schizophrenia spectrum disorders is not well understood. Current findings range from worse cognition, no difference, or better cognition among those patients abusing substances compared to those not abusing (Potvin, Stavro, & Pelletier, 2012).

It is common for people with schizophrenia spectrum disorders to undergo neuropsychological screening evaluations to document the nature and severity of their cognitive deficits. This information can be important for treatment planning (Spaulding et al., 1999). In addition, the nature

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and severity of cognitive deficits have implications for educational and vocational planning (Hoffmann, Kupper, Zbinden, & Hirsbrunner, 2003). When assessing the nature and severity of cognitive deficits, clinical normative data is particularly useful because it allows clinicians to describe patients' cognitive performance in terms of how they are functioning in comparison to other people with schizophrenia spectrum disorders (Iverson et al., 2009; Periáñez et al., 2007; Wilk et al., 2004). For example, a person with schizophrenia could perform very poorly compared to the standard healthy normative data but perform normally or even above expectations in comparison to other people with schizophrenia (using clinical normative data for comparison). Knowing this information might facilitate more targeted and personalized psychosocial rehabilitation planning (McGurk, Mueser, DeRosa, & Wolfe, 2009).

The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) is commonly used in research and clinical practice with people with schizophrenia (De la Torre, Perez, Ramallo, Randolph, & González-Villegas, 2016; Dickerson et al., 2004; Gogos et al., 2010; Harris et al., 2004; Helle et al., 2014; Hobart et al., 1999; Iverson et al., 2009; Loughland, Lewin, Carr, Sheedy, & Harris, 2007; Tucker & Bertke, 2019; Wang et al., 2019; Wilk et al., 2004; Zhang, Han et al., 2015; Zhang, Li et al., 2015; Zhang et al., 2012). Two prior studies have provided clinical normative data for the RBANS in people with schizophrenia disorders, one in the United States (Wilk et al., 2004) and one in Canada (Iverson et al., 2009). The purpose of this paper is to illustrate the importance and usefulness of clinical normative data for people with severe and persistent mental illness. Further, we will compare the clinical normative data for the RBANS reported by Iverson et al. (2009) to clinical normative data derived from the current sample, applying identical statistical procedures and presentation of results. We predict that the Norwegian clinical normative values will be fairly similar to those published by Iverson et al. (2009).

Method

Participants

This study uses anonymous data from a clinical sample of 335 patients, referred for neuropsychological assessment from psychiatric inpatient hospitals in Bergen, Norway. The study was evaluated by the Regional Committee for Medical and Health Research Ethics, and by the regional Data Protection Official on behalf of the Norwegian Data Protection Authority (DPA), which is the legislative authority for The Personal Data Act in Norway. Approval from the DPA was granted January 13, 2017. Inclusion criteria were 18–39 years of age, Norwegian as their first language, and symptoms of schizophrenia, psychosis, or hallucinations. Patients with psychotic symptoms due to known affective disorders were excluded ($n = 36$). Patients of immigrant parents were included if born and educated in Norway, but race or ethnicity were not recorded. Patients not born or educated in Norway were excluded ($n = 24$). Comorbid substance abuse was recorded in 134 (40.0%). Type and duration of substances abused were not recorded, but most substance abusing patients were long-time polysubstance abusers. Patients at the time of testing were usually in the process of undergoing differential diagnostic evaluations during their hospitalization. We found 323 registered diagnoses classified according to The International Statistical Classification of Diseases and Related Health Problems–10 (World Health Organization, 2004). The majority of patients had diagnoses of schizophrenia disorders (F20.0–F20.9) and schizoaffective disorders (F25.0–F25.9), accounting for 48.1%. Of those, 49.7% had F20.0 paranoid schizophrenia, 26.5% had schizoaffective disorders, and 23.9% had either undifferentiated schizophrenia (F20.3), simple schizophrenia (F20.6) or schizophrenia, unspecified (F20.9). Acute psychosis was diagnosed in 16.5% (F22.0–F23.9). Psychotic disorder due to substance abuse (F1x.5) was diagnosed in 16.1%. Unspecified nonorganic psychosis (F29) was diagnosed in 12.1%. A minority were awaiting diagnostic decision (10.9%), having a diagnosis of hallucinations (R44.0–44.8) or strange and inexplicable behavior (R46.2). The subjects ranged between 18–38 years in age, with a mean age of 24.17 years ($SD = 4.92$). Years of education ranged from 9–18 years, with a mean of 12.29 years ($SD = 1.83$). There were more men than women, 208 (62.1%) and 127 (37.9%), respectively.

In Norway, government-funded mental health clinics offering inpatient and outpatient treatment are available across the country. All treatment facilities are under the same legislation, follow national guidelines for assessment and treatment of mental illnesses, and report to mandatory national health registries. When comparing the current sample with that of a national registry-based prevalence study of substance abuse and mental illness (Nesvåg et al., 2015), we find similar rates of schizophrenia spectrum diagnosis, substance abuse, and sex-ratio to the overall schizophrenia spectrum patient population in Norway. For example, the difference between the present sample and the national registry in sex-ratio is less than 3%, for substance abuse it is less than 8%, and for ICD-10 diagnosis F20 Schizophrenia it is less than 6%.

Measures

All patients completed the Norwegian version of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS; Randolph, 2013) as part of a routine clinical assessment. This adult screening battery takes 20–40 minutes to administer. Five age-corrected Index scores with a mean score of 100 and a standard deviation of 15 are obtained (Immediate Memory, Visuospatial/Constructional, Language, Attention, and Delayed Memory), as well as a Total Scale. The Norwegian version of RBANS applies Scandinavian norms, matched to the population statistics of 2012 in Denmark, Norway, and Sweden (Randolph, 2013, p. 27). It is based on the U.S. version published in 1998 (Randolph, 1998), and has two alternative forms (A and B), whereas the current U.S. version has four forms (Randolph, 2012). The translations are described in the manual (Randolph, 2013, manual, pp. 8–9), and they were conducted as recommended in the International Test Commission

Guidelines for Translating and Adapting Tests (Gudmundsson, 2009). A detailed review of differences in instructions, scoring, and normative data is presented in Raudeberg, Iverson, & Hammar (2019).

Statistical analyses

Each patient was administered the RBANS using the standardized procedure in the Norwegian version of the manual (Randolph, 2013). Form A was administered to 183 (54.6%), Form B to 152 (45.4%). Index scores were calculated using Scandinavian norms for the age group 20–39 years, because applying U.S norms have been shown to overestimate cognitive functions in Norwegian patients with schizophrenia spectrum disorders (Raudeberg et al., 2019). A subset of the participants ($n = 208$) completed the Norwegian research version of the National Adult Reading Test (NART), which provides age and education adjusted measures of estimated premorbid IQ (Sundet & Vaskinn, 2008). They had a mean estimated premorbid Full Scale IQ (FSIQ) of 100.49 ($SD = 4.43$, Range = 90–117). The majority (79.8%) had estimated FSIQ scores in the range of 95–105 points, 8.7% had an estimated FSIQ < 95. Some participants ($n = 84$) completed the Norwegian version of the Wechsler Adult Intelligence Scale Fourth Edition (Wechsler, 2011). They had a mean WAIS-IV Full Scale IQ (FSIQ) of 84.52 ($SD = 12.73$, Range = 62–118). Descriptive statistics (e.g. mean, median, standard deviation, interquartile range, skewness, and kurtosis) for the age-adjusted RBANS Index standard scores were computed for the entire sample, by comorbid substance abuse (yes/no), by levels of educational attainment (less than high school, high school, and more than high school), and by gender.

The clinical normative data was computed using frequency analysis tables stratified by the above-mentioned groups. RBANS Index scores are presented based on Wechsler-Benton classifications, commonly used in neuropsychology, including: extremely low (≤ 2nd percentile), unusually low (3rd–9th percentiles), low average (10th–24th percentiles), average (25th–75th percentiles), high average (76th–90th percentiles), and superior (≥ 91st percentile). The prevalence of low scores was calculated by simultaneously examining all five RBANS index scores (Immediate Memory, Visuospatial/Constructional, Language, Attention, and Delayed Memory), rather than performance on each domain in isolation. The base rates of low domain scores were calculated by using four cutoff scores that might be routinely used in clinical practice, including: (a) more than one standard deviation (SD) below the mean (i.e. < 85), (b) below the 10th percentile (i.e. < 81), (c) at or below the 5th percentile (i.e. ≤ 76), and (d) more than two SDs below the mean (i.e. < 70). The prevalence of low scores is presented for the entire sample, by gender, by comorbid substance abuse (yes/no), by levels of educational attainment (less than high school, high school, and more than high school), by NART estimated FSIQ (i.e. less than 100 or 100 and higher), and by WAIS-IV Full Scale IQ (i.e. less than 80 or 80 and higher) in the subsample that underwent the more comprehensive evaluation.

Results

As seen in Table 1, the mean scores across the sample were one to two standard deviations below the mean for healthy adults. Notice that the average scores (i.e. at the 50th percentile) for patients with schizophrenia spectrum disorders are as follows: Immediate Memory Index = 78, Visuospatial/Constructional Index = 90, Language Index = 78, Attention Index = 70, Delayed Memory Index = 80, and Total Scale = 69.

There were no significant differences when comparing index scores for substance abusers with those not abusing substances (p-values ranging from 0.28–0.89). Men had significantly higher scores on the Immediate Memory Index, Visual/Constructional Index, and the Total Scale compared to women. Effect sizes were small (Cohen's $d = 0.30$, $d = 0.37$, and $d = 0.29$, respectively). Years of education were significantly correlated ($p < .001$) with all index scores and Total Scale scores (r_s ranged from 0.23–0.39). A one-way analysis of variance (ANOVA) revealed that there were significant main effects for education for all five Index scores and the Total Scale score. Patients with more than high school education performed significantly better on every Index score and the Total Scale score compared to patients with less than high school. They also performed better than those with high school education on Immediate Memory, Language, and Attention Indexes, and the Total Scale. There were no significant differences between patients that had completed high school and those who had not. Patients with higher NART estimated premorbid FSIQ and higher WAIS-IV FSIQ performed significantly better (p-values ranging from 0.009–<0.001) on all Indexes and the Total Scale score. Comparing patients with IQs lower than 80 with patients with IQs of 80 or higher, we found medium to large effect sizes for all Indexes (Immediate Memory: $d = 0.64$, Visuospatial/Constructional: $d = 0.73$, Language: $d = 0.86$, Attention: $d = 0.90$, Delayed Memory: $d = 0.88$, and Total Scale: $d = 1.13$).

The interpretive classifications for the clinical normative data are presented in Table 2. Using the descriptive classifications (and corresponding percentile range) of extremely low (≤ 2nd percentile), unusually low (3rd–9th percentiles), low average (10th–24th percentiles), average (25th–75th percentiles), high average (76th–90th percentiles), and superior (≥ 91st percentile), clinicians can see how a patient's performance on the RBANS Indexes compares to other patients with schizophrenia spectrum disorders. For example: (1) a Delayed Memory Index score of 50 is extremely low for healthy adults, but is low average for patients with schizophrenia spectrum disorders; (2) an Attention Index of 75 is unusually low for healthy adults, but average for younger patients with schizophrenia spectrum disorders; and (3) an Immediate Memory Index of 100 is average for healthy adults but superior for patients with schizophrenia spectrum disorders with less than high school education. Consider also that a score of 50 on the RBANS Total Scale, which later improves to a score of 69 at reassessment after inpatient treatment and a medication change, would continue to be extremely low for healthy individuals, but would

Table 1. Descriptive statistics for patients with schizophrenia spectrum disorder on the RBANS.

	RBANS indices					
Groups	Immediate memory	Visuospatial/ Constructional	Language	Attention	Delayed memory	Total scale
All patients ($N = 335$)						
Mean (*SD*)	78.50 (20.70)	86.50 (17.34)	77.48 (17.94)	69.67 (19.47)	79.02 (20.97)	68.98 (19.09)
Median (IQR)	78.00 (66–92)	90.00 (77–102)	78.00 (66–89)	70.00 (55–83)	80.00 (70–91)	69.00 (54–82)
Skew/Kurtosis	0.08/−0.36 (Y)	−0.74/−0.24 (N)	−0.19/−0.34 (N)	0.04/−0.50 (N)	−0.23/−0.28 (N)	0.20/−0.68 (N)
Men ($n = 208$)						
Mean (*SD*)	80.80 (19.83)	88.91 (15.96)	78.87 (17.65)	71.21 (18.80)	80.41 (20.14)	71.06 (18.25)
Median (IQR)	80.00 (68–95)	90.00 (77–102)	80.00 (66–93)	72.00 (62–84)	82.00 (73–93)	71.00 (59–83)
Skew/Kurtosis	0.06/−0.35 (N)	−0.79/−0.14 (N)	−0.19/−0.27 (N)	−0.11/−0.50 (N)	−0.31/−0.10 (N)	0.07/−0.62 (N)
Women ($n = 127$)						
Mean (*SD*)	74.72 (21.61)	82.55 (18.80)	75.21 (18.25)	67.14 (20.36)	76.73 (22.16)	65.57 (19.99)
Median (IQR)	75.00 (60–92)	84.00 (70–102)	78.00 (60–85)	69.00 (47–81)	80.00 (63–91)	65.00 (49–80)
Skew/Kurtosis	0.20/−0.30 (Y)	−0.58/−0.57 (N)	−0.18/−0.45 (N)	0.29/−0.34 (N)	−0.09/−0.46 (N)	0.47/−0.55 (Y)
No substance abuse ($n = 201$)						
Mean (*SD*)	78.75 (21.75)	87.33 (17.34)	76.62 (18.24)	70.04 (19.06)	79.15 (22.05)	69.53 (19.56)
Median (IQR)	78.00 (65–92)	90.00 (77–102)	78.00 (65–89)	72.00 (57–83)	80.00 (68–93)	69.00 (55–83)
Skew/Kurtosis	0.09/−0.42 (Y)	−0.81/−0.11 (N)	−0.23/−0.47 (N)	−0.01/−0.31 (N)	−0.13/−0.40 (N)	0.23/−0.64 (N)
Substance abuse ($n = 134$)						
Mean (*SD*)	78.12 (19.10)	85.25 (17.33)	78.77 (17.47)	69.11 (20.14)	78.82 (19.33)	68.15 (18.41)
Median (IQR)	78.00 (66–92)	90.00 (77–102)	78.00 (66–91)	70.00 (55–83)	80.00 (73–91)	69.00 (54–81)
Skew/Kurtosis	0.05/−0.31 (Y)	−0.66/−0.36 (N)	−0.12/−0.14 (N)	0.10/−0.71 (N)	−0.47/−0.10 (N)	0.14/−0.80 (N)
<High school ($n = 196$)						
Mean (*SD*)	74.21 (20.21)	83.64 (17.70)	75.57 (16.47)	64.99 (17.56)	75.12 (21.00)	64.11 (17.70)
Median (IQR)	73.00 (60–89)	84.00 (75–102)	78.00 (65–87)	68.00 (49–77)	77.00 (63–88)	64.00 (49–77)
Skew/Kurtosis	0.15/−0.43 (Y)	−0.56/−0.47 (N)	−0.25/−0.32 (N)	−0.06/−0.95 (N)	−0.26/−0.76 (N)	0.29/−0.74 (N)
High school ($n = 68$)						
Mean (*SD*)	78.79 (19.39)	87.26 (17.82)	75.37 (19.07)	69.91 (21.36)	80.60 (19.67)	69.32 (17.64)
Median (IQR)	78.00 (67–92)	90.00 (77–102)	76.50 (59–89)	71.00 (51–84)	82.00 (73–91)	71.50 (55–82)
Skew/Kurtosis	−0.10/−0.12 (Y)	−0.93/0.09 (N)	−0.23/−0.72	0.26/−0.25 (N)	−0.34/0.27 (N)	−0.04/−0.63 (Y)
>High school ($n = 71$)						
Mean (*SD*)	90.04 (18.99)	93.65 (13.53)	84.77 (19.06)	82.34 (17.02)	88.27 (19.19)	82.08 (18.08)
Median (IQR)	92.00 (75–102)	96.00 (84–102)	85.00 (75–97)	81.00 (72–94)	88.00 (74–100)	81.00 (68–96)
Skew/Kurtosis	0.15/−0.40 (Y)	−10.01/0.08 (N)	−0.38/−0.04 (Y)	−0.26/0.32 (Y)	0.10/0.17 (Y)	0.00/−0.82 (Y)

RBANS: The repeatable battery for assessment of neuropsychological status; SD: standard deviation; IQR: interquartile range. (Y) = yes and (N) = no for approximating a normal distribution based on the Kolmogorov–Smirnov test with Lilliefors Significance Correction.

move a patient with schizophrenia spectrum disorder from low average to average; an improvement that would not be readily apparent when using standard normative tables.

The prevalence of low scores is presented in Table 3 for the entire sample, by gender, by levels of educational attainment (less than high school, high school, and more than high school), by NART estimated Full Scale IQ (i.e. less than 100 or 100 and higher), and by WAIS-IV Full Scale IQ (i.e. less than 80 or 80 and higher). In the entire sample, 79.1% had two or more index scores below one *SD*, 63.3% had two or more at or below the 5th percentile, and 40.0% had two or more index scores below two *SDs*. The base rates of low scores varied by education. In this sample, 86.7% of the patients with less than high school education, 79.4% of the patients with high school education, and 57.7% of patients with more than high school education had two or more index scores one or more *SDs* below the mean [χ^2 (2) = 26.50, $p < .001$, $V = 0.281$]. Regarding frankly impaired scores, 50.5% of the patients with less than high school education, 30.9% of the patients with high school education, and 19.7% of patients with more than high school education had two or more index scores two *SDs* below the mean [χ^2 (2) = 23.55, $p < .001$, $V = 0.265$].

Higher base rates of low scores were also more common in those people with lower intellectual abilities. In patients with NART FSIQ scores below 100, 91.4% obtained two or more low scores (i.e. < 1 SD), whereas patients with NART FSIQ scores 100 or higher, 73.9% obtained two or more scores < 1 SD [χ^2 (1)=10.53, $p = .002$, $\phi = -0.25$]. In patients with NART FSIQ scores below 100, 51.1% obtained two or more frankly impaired index scores (i.e. < 2 *SDs*) compared to 27.8% of patients with NART FSIQ scores 100 or higher [χ^2 (1) = 19.39, $p < .001$, $\phi = -0.31$]. In patients with WAIS-IV FSIQ scores below 80, 100% obtained three or more low scores (i.e. < 1 SD), whereas patients with WAIS-IV FSIQ scores 80 or higher, 65.7% obtained three or more scores < 1 SD [χ^2 (1) = 11.45, $p = .001$, $\phi = -0.40$]. In patients with WAIS-IV FSIQ scores below 80, 85.3% obtained two or more frankly impaired index scores (i.e. < 2 *SDs*) compared to 40.0% of patients with WAIS-IV FSIQ scores 80 or higher [χ^2 (1)=19.47, $p < .001$, $\phi = -0.51$].

Discussion

The goal of this study was to present clinical normative data for the RBANS for Norwegian patients with schizophrenia spectrum disorders, and to compare these norms with previously published norms of similar patient groups in North America. Overall, the performance of the current patient sample was similar to the clinical normative data for inpatients and outpatients with schizophrenia disorders presented by Iverson et al. (2009) in Canada and Wilk et al. (2004) in the United States. The average Total Scale scores reported in these studies differed from the average Total

Table 2. Clinical normative data for patients with schizophrenia spectrum disorder: RBANS index scores corresponding to classification ranges.

	Extremely low	Unusually low	Low average	Average	High average	Superior
All patients ($N = 335$)						
Immediate memory	–	40–47	48–65	66–91	92–105	106+
Visuospatial/Constructional	40–47	48–59	60–76	77–101	102–107	–
Language	–	40–51	52–65	66–89	90–99	100+
Attention	–	–	40–54	55–82	83–94	95+
Delayed memory	–	40–42	43–69	70–91	92–105	106+
Total scale	–	–	40–53	54–82	83–95	96+
Men ($n = 208$)						
Immediate memory	40	41–52	53–67	68–94	95–109	110+
Visuospatial/constructional	40–52	53–63	64–76	77–101	102–107	–
Language	–	40–52	53–65	66–92	93–98	99+
Attention	–	–	40–60	61–83	84–95	96+
Delayed memory	–	40–44	45–72	73–92	93–107	108+
Total scale	–	40–43	44–59	60–82	83–96	97+
Women ($n = 127$)						
Immediate memory	–	40	41–57	58–92	93–99	100+
Visuospatial/constructional	–	40–53	54–69	70–102	103–107	–
Language	–	40–44	45–60	61–85	86–100	101+
Attention	–	–	40–45	46–81	82–93	94+
Delayed memory	–	–	40–62	63–91	92–104	105+
Total scale	–	–	40–48	49–79	80–93	94+
<High school ($n = 196$)						
Immediate memory	–	40–43	44–58	59–88	89–99	100+
Visuospatial/constructional	40–44	45–56	57–70	71–101	102–107	–
Language	–	40–52	53–60	61–87	88–95	96+
Attention	–	–	40–47	48–77	78–88	89+
Delayed memory	–	–	40–58	59–88	89–101	102+
Total scale	–	–	40–48	49–77	78–90	91+
High school ($n = 68$)						
Immediate memory	–	40–46	47–66	67–92	93–109	110+
Visuospatial/constructional	–	40–58	59–76	77–102	103–107	–
Language	–	40–42	43–58	59–89	90–101	102+
Attention	–	–	40–49	50–83	84–97	98+
Delayed memory	–	40–46	47–72	73–90	91–104	105+
Total scale	–	40–41	42–53	54–81	82–90	91+
>High school ($n = 71$)						
Immediate memory	40–53	54–65	66–74	75–101	102–120	121+
Visuospatial/constructional	40–59	60–69	70–83	84–102	103–107	–
Language	–	40–57	58–72	73–97	98–109	110+
Attention	–	40–64	65–70	71–93	94–105	106+
Delayed memory	40–44	45–69	70–74	75–99	100–118	119+
Total scale	40–50	51–60	61–67	68–96	97–105	106+

RBANS: The repeatable battery for assessment of neuropsychological status.

Scale score in the current sample by 0.18 (Iverson et al., 2009) and 1.56 (Wilk et al., 2004) points. The mean Index scores reported by (Iverson et al., 2009) differed on average 3.27 points for all five indexes; the largest difference was for the Immediate Memory Index (8.80) and least for the Attention Index (2.03). To our knowledge, it has not been previously reported that Norwegian patients with schizophrenia spectrum disorders have similar RBANS Index scores to comparable patient groups in North America.

Clinical normative data allows a clinician to determine if a patient's cognition is worse, similar, or better than other patients with schizophrenia spectrum disorders (Iverson et al., 2009; Periáñez et al., 2007; Wilk et al., 2004). Stratifying by educational attainment and by IQ-levels provide information on expected performance when considering the influence of these variables on test performance on the RBANS (Gold, Queern, Iannone, & Buchanan, 1999; Iverson et al., 2009; Wilk et al., 2004). The strong association between level of education, NART-predicted level of intelligence, and RBANS performance is not surprising. People with schizophrenia spectrum disorders who have higher levels of education might, on average, have a later disease onset (Chen, Selvendra, Stewart, & Castle, 2018), lower levels of psychotic symptomatology (Swanson, Gur, Bilker, Petty, & Gur, 1998), and more cognitive reserve (de la Serna et al., 2013; Holthausen et al., 2002).

In the current sample, women had lower scores than men on all RBANS Indexes and the Total Scale, which also has been reported for Australian patients (Gogos et al., 2010), but not in samples in North America or China (Han et al., 2012; Iverson et al., 2009; Loughland et al., 2007; Wilk et al., 2004; Zhang, Han et al., 2015; Zhang et al., 2012). This finding suggests that the normative tables presented here should have considered education and intelligence together with gender, rather than each in isolation. However, the number of subjects would then be too few for some categories to be representative. For example, only 26 women in the current sample have a NART-predicted level of intelligence of $\geq$ 100; of those 10 had less than high school education, 4 had completed high school, and 12 had more than high school education. Further, the effect of gender on RBANS performance was noticeably smaller than that of education and intelligence, suggesting that educational attainment and IQ-levels might be more important variables to consider than gender when evaluating RBANS performance.

Table 3. Base rates of low RBANS index scores in patients with schizophrenia spectrum disorder.

		Gender		Level of education			Intellectual abilities			
Number of index scores below cutoff	All patients ($N = 335$)	Men ($n = 208$)	Women ($n = 127$)	<High school ($n = 196$)	High school ($n = 68$)	>High school ($n = 71$)	NART FSIQ <100 ($n = 93$)	NART FSIQ ≥100 ($n = 115$)	WAIS-IV FSIQ <80 ($n = 34$)	WAIS-IV FSIQ ≥80 ($n = 50$)
< 1 *SD*										
1 or more	93.7	92.8	95.3	96.4	95.6	84.5	95.7	93.0	–	93.7
2 or more	79.1	76.4	83.5	86.7	79.4	57.7	91.4	73.9	–	79.1
3 or more	65.7	61.5	72.4	73.0	67.6	43.7	80.6	54.8	100.0	65.7
4 or more	45.4	40.4	53.5	53.6	42.6	25.4	60.2	35.7	82.4	45.4
5	21.5	16.8	29.1	29.6	14.7	5.6	32.3	11.3	44.1	44.1
< 10th percentile										
1 or more	88.7	88.5	89.0	92.9	91.2	74.6	94.6	86.1	–	88.7
2 or more	73.7	71.6	77.2	82.1	73.5	50.7	87.1	67.8	–	73.7
3 or more	56.1	52.4	62.2	64.3	54.4	35.2	68.8	45.2	100.0	56.1
4 or more	37.0	32.7	44.1	45.9	33.8	15.5	48.4	27.8	76.5	37.0
5	14.6	11.5	19.7	19.9	10.3	4.2	21.5	7.0	32.4	14.6
≤ 5th percentile										
1 or more	81.8	80.3	84.3	87.2	82.4	66.2	87.1	79.1	–	81.8
2 or more	63.3	60.6	67.7	71.4	64.7	39.4	75.3	48.7	100.0	63.3
3 or more	42.4	38.0	49.6	52.6	32.4	23.9	57.0	28.7	85.3	42.4
4 or more	24.2	21.2	29.1	31.1	23.5	5.6	30.1	16.5	50.0	24.2
5	9.0	7.2	11.8	11.7	8.8	1.4	15.1	3.5	23.5	9.0
< 2 *SDs*										
1 or more	66.0	64.4	68.5	74.0	64.7	45.1	80.6	55.7	97.1	66.0
2 or more	40.0	35.6	47.2	50.5	30.9	19.7	58.1	27.8	85.3	40.0
3 or more	23.9	17.8	33.9	31.1	23.5	4.2	31.2	16.5	52.9	23.9
4 or more	13.4	8.2	22.0	16.8	14.7	2.8	18.3	9.6	29.4	13.4
5	3.0	1.0	6.3	3.1	5.9	0.0	5.4	0.0	14.7	3.0

Values represent cumulative percentages of people.
NART: National Adult Reading Test (Norwegian research version); WAIS-IV: Wechsler Adult Intelligence Scale-Fourth Edition; FSIQ: Full Scale Intelligence Quotient.

The base rates information presented in Table 3 facilitates the interpretation of all five RBANS index scores simultaneously in patients with schizophrenia spectrum diagnoses. Having several low Index scores is common. For example, 79.1% had two or more Index scores more than one *SD* below the mean, 63.3% had two or more Index scores at or below the 5th percentile, and 40% had two or more Index scores below two *SDs*. These findings are fairly similar to those reported by Iverson et al. (2009). Higher base rates of low RBANS Index scores were more common for patients with lower education and lower intellectual abilities, as reported in previous studies (Iverson et al., 2009; Wilk et al., 2004).

The present RBANS normative data provide information regarding performance on the RBANS for Norwegian patients with schizophrenia spectrum disorders. This information is important for clinicians. Demonstrating that a patient with a schizophrenia spectrum disorder has cognitive deficits is useful, but to further differentiate whether the deficit is severe, moderate, or mild compared to other patients in the same diagnostic group might allow for more precise and better targeted treatment and rehabilitation decisions (Iverson et al., 2009; Periáñez et al., 2007; Wilk et al., 2004).

The RBANS has been used to measure cognitive impairment in schizophrenia spectrum disorders in North America, Europe, and Asia (Anda et al., 2016; Azizian, Yeghiyan, Ishkhanyan, Manukyan, & Khandanyan, 2011; Chianetta, Lefebvre, LeBlanc, & Grignon, 2008; de Girolamo et al., 2014; De la Torre et al., 2016; Dickerson et al., 2004; Ehrenreich et al., 2007; Gogos et al., 2010; Gold et al., 1999; Halász, Levy-Gigi, Kelemen, Benedek, & Kéri, 2013; Han et al., 2012; Harris et al., 2004; Helle et al., 2014; Hobart et al., 1999; Iverson et al., 2009; Juhász, Kemény, Linka, Sántha, & Bartkó, 2003; Kelemen, Kiss, Benedek, & Kéri, 2013; Loughland et al., 2007; Raudeberg et al., 2019; Sanz, Vargas, & Marín, 2009; Takeuchi et al., 2013; Wang et al., 2019; Wilk et al., 2004; Zhang, Han et al., 2015; Zhang, Li et al., 2015; Zhang et al., 2012, 2018). It might be helpful to replicate the present study (Iverson et al., 2009 and Wilk et al., 2004) in a few more countries to extract common themes of impairment in schizophrenia spectrum disorders across cultures. In particular, educational attainment seems important for assessing the clinical meaningfulness of RBANS scores in Canada, the U.S., and in Norway. This effect might be more or less pronounced in other countries, because educational systems differ substantially between nations. Also, gender differences in performance on the RBANS might be important in schizophrenia spectrum disorders, but as shown in the current study, gender differences in Norway are not similar to findings in North America but seem more similar to findings in Australia (Gogos et al., 2010). The main point is that cognitive impairment might differ somewhat across cultures and might have different impact on functional outcome.

Conclusions

The present study showed that Norwegian patients with schizophrenia spectrum disorders have cognitive deficits similar to patient populations in North America and that these measures of deficits have a similar distribution of severe, moderate, mild, and no impairment. RBANS Index scores varied by gender, education, and IQ within people with schizophrenia spectrum disorders, but not by comorbid substance abuse in the present sample. Stratified clinical normative values, such as those presented in the current study, can be useful when assessing individual patients' neuropsychological profiles. This is important when planning treatment and rehabilitation programs.

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References

Anda, L., Brønnick, K. S., Johnsen, E., Kroken, R. A., Jørgensen, H., & Løberg, E.-M. (2016). The course of neurocognitive changes in acute psychosis: Relation to symptomatic improvement. *PLoS One*, *11*(12), e0167390. doi:10.1371/journal.pone.0167390

Azizian, A., Yeghiyan, M., Ishkhanyan, B., Manukyan, Y., & Khandanyan, L. (2011). Clinical validity of the repeatable battery for the assessment of neuropsychological status among patients with schizophrenia in the Republic of Armenia. *Archives of Clinical Neuropsychology*, *26*(2), 89–97. doi:10.1093/arclin/acq100

Barder, H. E., Sundet, K., Rund, B. R., Evensen, J., Haahr, U., Ten Velden Hegelstad, W., … Friis, S. (2013). Ten year neurocognitive trajectories in first-episode psychosis. *Frontiers in Human Neuroscience*, *7*, 643. doi:10.3389/fnhum.2013.00643

Chen, L., Selvendra, A., Stewart, A., & Castle, D. (2018). Risk factors in early and late onset schizophrenia. *Comprehensive Psychiatry*, *80*, 155–162. doi:10.1016/j.comppsych.2017.09.009

Chianetta, J.-M., Lefebvre, M., LeBlanc, R., & Grignon, S. (2008). Comparative psychometric properties of the BACS and RBANS in patients with schizophrenia and schizoaffective disorder. *Schizophrenia Research*, *105*(1–3), 86–94. doi:10.1016/j.schres.2008.05.024

de Girolamo, G., Candini, V., Buizza, C., Ferrari, C., Boero, M. E., Giobbio, G. M., … Rossi, G. (2014). Is psychiatric residential facility discharge possible and predictable? A multivariate analytical approach applied to a prospective study in Italy. *Social Psychiatry and Psychiatric Epidemiology*, *49*(1), 157–167. doi:10.1007/s00127-013-0705-z

de la Serna, E., Andrés-Perpiñá, S., Puig, O., Baeza, I., Bombin, I., Bartrés-Faz, D., … Castro-Fornieles, J. (2013). Cognitive reserve as

a predictor of two year neuropsychological performance in early onset first-episode schizophrenia. *Schizophrenia Research*, *143*(1), 125–131. doi:10.1016/J.SCHRES.2012.10.026

De la Torre, G. G., Perez, M. J., Ramallo, M. A., Randolph, C., & González-Villegas, M. B. (2016). Screening of cognitive impairment in schizophrenia. *Assessment*, *23*(2), 221–231. doi:10.1177/1073191115583715

Dickerson, F., Boronow, J. J., Stallings, C., Origoni, A. E., Cole, S. K., & Yolken, R. H. (2004). Cognitive functioning in schizophrenia and bipolar disorder: Comparison of performance on the repeatable battery for the assessment of neuropsychological status. *Psychiatry Research*, *129*(1), 45–53. doi:10.1016/j.psychres.2004.07.002

Egeland, J., Sundet, K., Rund, BØR. R., AsbjØRnsen, A., Hugdahl, K., LandrØ, N. I., … Stordal, K. I. (2003). Sensitivity and specificity of memory dysfunction in schizophrenia: A comparison with major depression. *Journal of Clinical and Experimental Neuropsychology*, *25*(1), 79–93. doi:10.1076/jcen.25.1.79.13630

Ehrenreich, H., Hinze-Selch, D., Stawicki, S., Aust, C., Knolle-Veentjer, S., Wilms, S., … Krampe, H. (2007). Improvement of cognitive functions in chronic schizophrenic patients by recombinant human erythropoietin. *Molecular Psychiatry*, *12*(2), 206–220. doi:10.1038/sj.mp.4001907

Galaverna, F. S., Morra, C. A., & Bueno, A. M. (2014). Severity of negative symptoms significantly affects cognitive functioning in patients with chronic schizophrenia: The slowing in cognitive processing. *The European Journal of Psychiatry*, *28*(3), 145–153. doi:10.4321/S0213-61632014000300002

Gogos, A., Joshua, N., & Rossell, S. L. (2010). Use of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) to investigate group and gender differences in schizophrenia and bipolar disorder. *Australian and New Zealand Journal of Psychiatry*, *44*(3), 220–229. doi:10.3109/00048670903446882

Gold, J. M., Queern, C., Iannone, V. N., & Buchanan, R. W. (1999). Repeatable battery for the assessment of neuropsychological status as a screening test in schizophrenia I: Sensitivity, reliability, and validity. *The American Journal of Psychiatry*, *156*(12), 1944–1950. doi:10.1176/ajp.156.12.1944

Gudmundsson, E. (2009). Guidelines for translating and adapting psychological instruments. *Nordic Psychology*, *61*(2), 29–45. doi:10.1027/1901-2276.61.2.29

Halász, I., Levy-Gigi, E., Kelemen, O., Benedek, G., & Kéri, S. (2013). Neuropsychological functions and visual contrast sensitivity in schizophrenia: The potential impact of comorbid posttraumatic stress disorder (PTSD). *Frontiers in Psychology*, *4*, 136. doi:10.3389/fpsyg.2013.00136

Han, M., Huang, X.-F., Chen, D. C., Xiu, M. H., Hui, L., Liu, H., … Zhang, X. Y. (2012). Gender differences in cognitive function of patients with chronic schizophrenia. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, *39*(2), 358–363. doi:10.1016/j.pnpbp.2012.07.010

Harris, J. G., Kongs, S., Allensworth, D., Martin, L., Tregellas, J., Sullivan, B., … Freedman, R. (2004). Effects of nicotine on cognitive deficits in schizophrenia. *Neuropsychopharmacology*, *29*(7), 1378–1385. doi:10.1038/sj.npp.1300450

Helle, S., Gjestad, R., Johnsen, E., Kroken, R. A., Jørgensen, H. A., & Løberg, E.-M. (2014). Cognitive changes in patients with acute phase psychosis—effects of illicit drug use. *Psychiatry Research*, *220*(3), 818–824. doi:10.1016/j.psychres.2014.08.062

Hobart, M. P., Goldberg, R., Bartko, J. J., & Gold, J. M. (1999). Repeatable battery for the assessment of neuropsychological status as a screening test in schizophrenia, II: Convergent/discriminant validity and diagnostic group comparisons. *American Journal of Psychiatry*, *156*(12), 1951–1957. doi:10.1176/ajp.156.12.1951

Hoffmann, H., Kupper, Z., Zbinden, M., & Hirsbrunner, H.-P. (2003). Predicting vocational functioning and outcome in schizophrenia outpatients attending a vocational rehabilitation program. *Social Psychiatry and Psychiatric Epidemiology*, *38*(2), 76–82. doi:10.1007/s00127-003-0603-x

Holmen, A., Juuhl-Langseth, M., Thormodsen, R., Melle, I., & Rund, B. R. (2010). Neuropsychological profile in early-onset schizophrenia-spectrum disorders: Measured with the matrics battery. *Schizophrenia Bulletin*, *36*(4), 852–859. doi:10.1093/schbul/sbn174

Holthausen, E. A., Wiersma, D., Sitskoorn, M. M., Hijman, R., Dingemans, P. M., Schene, A. H., & van den Bosch, R. J. (2002). Schizophrenic patients without neuropsychological deficits: Subgroup, disease severity or cognitive compensation? *Psychiatry Research*, *112*(1), 1–11. doi:10.1016/S0165-1781(02)00184-1

Iverson, G. L., Brooks, B. L., & Haley, G. M. T. (2009). Interpretation of the RBANS in inpatient psychiatry: Clinical normative data and prevalence of low scores for patients with schizophrenia. *Applied Neuropsychology*, *16*(1), 31–41. doi:10.1080/09084280802644128

Juhász, L. Z., Kemény, K., Linka, E., Sántha, J., & Bartkó, G. (2003). The use of RBANS test (Repeatable Battery for the Assessment of Neuropsychological Status) in neurocognitive testing of patients suffering from schizophrenia and dementia. *Ideggyogyaszati Szemle*, *56*(9–10), 303–308. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/14608951

Keefe, R. S. E. (2014). The longitudinal course of cognitive impairment in schizophrenia. *The Journal of Clinical Psychiatry*, *75*(suppl 2), 8–13. doi:10.4088/JCP.13065su1.02

Kelemen, O., Kiss, I., Benedek, G., & Kéri, S. (2013). Perceptual and cognitive effects of antipsychotics in first-episode schizophrenia: The potential impact of GABA concentration in the visual cortex. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, *47*, 13–19. doi:10.1016/J.PNPBP.2013.07.024

Loughland, C. M., Lewin, T. J., Carr, V. J., Sheedy, J., & Harris, A. W. (2007). RBANS neuropsychological profiles within schizophrenia samples recruited from non-clinical settings. *Schizophrenia Research*, *89*(1–3), 232–242. doi:10.1016/J.SCHRES.2006.08.022

Lysaker, P. H., Bryson, G. J., Davis, L. W., & Bell, M. D. (2005). Relationship of impaired processing speed and flexibility of abstract thought to improvements in work performance over time in schizophrenia. *Schizophrenia Research*, *75*(2–3), 211–218. doi:10.1016/j.schres.2004.09.014

McGurk, S. R., Mueser, K. T., DeRosa, T. J., & Wolfe, R. (2009). Work, recovery, and comorbidity in schizophrenia: A randomized controlled trial of cognitive remediation. *Schizophrenia Bulletin*, *35*(2), 319–335. doi:10.1093/schbul/sbn182

Nesvåg, R., Knudsen, G. P., Bakken, I. J., Høye, A., Ystrom, E., Surén, P., … Reichborn-Kjennerud, T. (2015). Substance use disorders in schizophrenia, bipolar disorder, and depressive illness: A registry-based study. *Social Psychiatry and Psychiatric Epidemiology*, *50*(8), 1267–1276. doi:10.1007/s00127-015-1025-2

Øie, M., Sundet, K., & Ueland, T. (2011). Neurocognition and functional outcome in early-onset schizophrenia and attention-deficit/hyperactivity disorder: A 13-year follow-up. *Neuropsychology*, *25*(1), 25–35. doi:10.1037/a0020855

Periáñez, J. A., Ríos-Lago, M., Rodríguez-Sánchez, J. M., Adrover-Roig, D., Sánchez-Cubillo, I., Crespo-Facorro, B., … Barceló, F. (2007). Trail Making Test in traumatic brain injury, schizophrenia, and normal ageing: Sample comparisons and normative data. *Archives of Clinical Neuropsychology*, *22*(4), 433–447. doi:10.1016/J.ACN.2007.01.022

Potvin, S., Stavro, K., & Pelletier, J. (2012). Paradoxical cognitive capacities in dual diagnosis schizophrenia: The quest for explanatory factors. *Journal of Dual Diagnosis*, *8*(1), 35–47. doi:10.1080/15504263.2012.648549

Rajji, T. K., Miranda, D., & Mulsant, B. H. (2014). Cognition, function, and disability in patients with schizophrenia: A review of longitudinal studies. *The Canadian Journal of Psychiatry*, *59*(1), 13–17. doi:10.1177/070674371405900104

Randolph, C. (1998). *Repeatable battery for the assessment of neuropsychological status: RBANS*. San Antonio: Pearson.

Randolph, C. (2012). *RBANS update: Repeatable battery for the assessment of neuropsychological status*. San Antonio: Pearson.

Randolph, C. (2013). *Repeatable battery for the assessment of neuropsychological status RBANS; Norwegian manual*. Enschede, NL: Pearson.

Raudeberg, R., Iverson, G. L., & Hammar, Å. (2019). Norms matter: U.S. normative data under-estimate cognitive deficits in Norwegians with schizophrenia spectrum disorders. *The Clinical Neuropsychologist*, *33*(sup1), 58–74. doi:10.1080/13854046.2019.1590641

Reichenberg, A., Caspi, A., Harrington, H., Houts, R., Keefe, R. S. E., Murray, R. M., … Moffitt, T. E. (2010). Static and dynamic cognitive deficits in childhood preceding adult schizophrenia: A 30-year study. *American Journal of Psychiatry*, *167*(2), 160–169. doi:10.1176/appi.ajp.2009.09040574

Ringen, P. A., Melle, I., Birkenaes, A. B., Engh, J. A., Faerden, A., Jónsdóttir, H., … Andreassen, O. A. (2007). Illicit drug use in patients with psychotic disorders compared with that in the general population: A cross-sectional study. *Acta Psychiatrica Scandinavica*, *117*(2), 133–138. doi:10.1111/j.1600-0447.2007.01135.x

Rosenheck, R., Leslie, D., Keefe, R., McEvoy, J., Swartz, M., Perkins, D., … Lieberman, J. (2006). Barriers to employment for people with schizophrenia. *American Journal of Psychiatry*, *163*(3), 411–417. doi:10.1176/appi.ajp.163.3.411

Sanz, J. C., Vargas, M. L., & Marín, J. J. (2009). Battery for assessment of neuropsychological status (RBANS) in schizophrenia: A pilot study in the Spanish population. *Acta Neuropsychiatrica*, *21*(1), 18–25. doi:10.1111/j.1601-5215.2008.00341.x

Savilla, K., Kettler, L., & Galletly, C. (2008). Relationships between cognitive deficits, symptoms and quality of life in schizophrenia. *Australian and New Zealand Journal of Psychiatry*, *42*(6), 496–504. doi:10.1080/00048670802050512

Schaefer, J., Giangrande, E., Weinberger, D. R., & Dickinson, D. (2013). The global cognitive impairment in schizophrenia: Consistent over decades and around the world. *Schizophrenia Research*, *150*(1), 42–50. doi:10.1016/j.schres.2013.07.009

Simonsen, C., Sundet, K., Vaskinn, A., Birkenaes, A. B., Engh, J. A., Faerden, A., … Andreassen, O. A. (2011). Neurocognitive dysfunction in bipolar and schizophrenia spectrum disorders depends on history of psychosis rather than diagnostic group. *Schizophrenia Bulletin*, *37*(1), 73–83. doi:10.1093/schbul/sbp034

Spaulding, W. D., Fleming, S. K., Reed, D., Sullivan, M., Storzbach, D., & Lam, M. (1999). Cognitive Functioning in Schizophrenia: Implications for Psychiatric Rehabilitation. *Schizophrenia Bulletin*, *25*(2), 275–289. doi:10.1093/oxfordjournals.schbul.a033378

Sponheim, S. R., Jung, R. E., Seidman, L. J., Mesholam-Gately, R. I., Manoach, D. S., O'Leary, D. S., … Schulz, S. C. (2010). Cognitive deficits in recent-onset and chronic schizophrenia. *Journal of Psychiatric Research*, *44*(7), 421–428. doi:10.1016/j.jpsychires.2009.09.010

Sundet, K., & Vaskinn, A. (2008). Beregning av IQ ved hjelp av lesetesten NART: Redusert funksjon fra premorbid nivå ved schizofreni og bipolar lidelse. *Tidsskrift for Norsk Psykologforening*, *45*(9), 1108–1115. Retrieved from https://psykologtidsskriftet.no/fagartikkel/2008/09/beregning-av-iq-ved-hjelp-av-lesetesten-nart-redusert-funksjon-fra-premorbid

Swanson, C. L., Gur, R. C., Bilker, W., Petty, R. G., & Gur, R. E. (1998). Premorbid educational attainment in schizophrenia: Association with symptoms, functioning, and neurobehavioral measures. *Biological Psychiatry*, *44*(8), 739–747. doi:10.1016/S0006-3223(98)00046-8

Takeuchi, H., Suzuki, T., Remington, G., Bies, R. R., Abe, T., Graff-Guerrero, A., … Uchida, H. (2013). Effects of risperidone and olanzapine dose reduction on cognitive function in stable patients with schizophrenia: An open-label, randomized, controlled, pilot study. *Schizophrenia Bulletin*, *39*(5), 993–998. doi:10.1093/schbul/sbt090

Tucker, J. D., & Bertke, A. S. (2019). Assessment of cognitive impairment in HSV-1 positive schizophrenia and bipolar patients: Systematic review and meta-analysis. *Schizophrenia Research*, *209*, 40. doi:10.1016/j.schres.2019.01.001

Vaskinn, A., Sundet, K., Friis, S., Simonsen, C., Birkenaes, A. B., Jónsdóttir, H., … Andreassen, O. A. (2008). Emotion perception and learning potential: Mediators between neurocognition and social problem-solving in schizophrenia? *Journal of the International Neuropsychological Society*, *14*(2), 279–288. doi:10.1017/S1355617708080314

Wang, Y.-Y., Wang, S., Zheng, W., Zhong, B.-L., Ng, C. H., Ungvari, G. S., … Li, X.-H. (2019). Cognitive functions in smoking and non-smoking patients with schizophrenia: A systematic review and meta-analysis of comparative studies. *Psychiatry Research*, *272*, 155–163. doi:10.1016/j.psychres.2018.12.064

Wechsler, D. (2011). *Wechsler Adult Intelligence Scale–fourth edition (Norwegian translation)*. Enschede, NL: Pearson.

Wilk, C. M., Gold, J. M., Humber, K., Dickerson, F., Fenton, W. S., & Buchanan, R. W. (2004). Brief cognitive assessment in schizophrenia: Normative data for the repeatable battery for the assessment of neuropsychological status. *Schizophrenia Research*, *70*(2–3), 175–186. doi:10.1016/j.schres.2003.10.009

World Health Organization. (2004). *International statistical classification of diseases and related health problems*. Geneva: World Health Organization.

Zhang, X. Y., Chen, D. C., Xiu, M. H., Yang, F., De Haile, C. N., Kosten, T. A., & … Osten, T. R. (2012). Gender differences in never-medicated first-episode schizophrenia and medicated chronic schizophrenia patients. *The Journal of Clinical Psychiatry*, *73*(07), 1025–1033. doi:10.4088/JCP.11m07422

Zhang, X. Y., Du, X., Yin, G., Zhang, Y., Chen, D., Xiu, M., … Soares, J. C. (2018). Prevalence and clinical correlates of and cognitive function at the time of suicide attempts in first-episode and drug-naive patients with schizophrenia. *The Journal of Clinical Psychiatry*, *79*(4), 7m11797. doi:10.4088/JCP.17m11797

Zhang, B. H., Han, M., Zhang, X. Y., Hui, L., Jiang, S. R., Yang, F. D., … Huang, X. F. (2015). Gender differences in cognitive deficits in schizophrenia with and without diabetes. *Comprehensive Psychiatry*, *63*, 1–9. doi:10.1016/j.comppsych.2015.07.003

Zhang, T., Li, H., Stone, W. S., Woodberry, K. A., Seidman, L. J., Tang, Y., … Wang, J. (2015). Neuropsychological impairment in prodromal, first-episode, and chronic psychosis: Assessing RBANS performance. *PLOS One*, *10*(5), e0125784. doi:10.1371/journal.pone.0125784