Norms Matter: U.S. Normative Data Under-Estimate Cognitive Deficits in Norwegians with Schizophrenia Spectrum Disorders

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Abstract

Objective: To illustrate and quantify how using different normative systems influences the accuracy of identifying cognitive impairment in people with schizophrenia spectrum disorders. **Participants and Methods:** A convenience sample of 315 patients between 18–38 years of age referred for neuropsychological assessment at a psychiatric inpatient hospital in Bergen, Norway was included. All completed the Norwegian version of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). **Results:** There were statistically significant differences between the Immediate Memory, Visuospatial/Constructional, Language, Delayed Memory and Total Scale Index scores when comparing the U.S. normative scores to the Scandinavian normative scores. The effect sizes were medium. The patient samples scored higher when using the U.S. normative data, suggesting less cognitive impairment. **Conclusions:** United States normative data yielded less impaired scores for Norwegians with schizophrenia spectrum disorders. The implications of using U.S. versus Scandinavian normative data are discussed.

Keywords: Schizophrenia; Cross Cultural Differences; Test Norms; Drug Abuse; RBANS

Introduction

Deficit measurement is the *sine qua non* of neuropsychological assessment. The accurate assessment of cognitive impairment requires that an examinee's performance be compared to normative reference values from people who are demographically similar. It is well established that neuropsychological test scores differ in association with age, sex, education, race/ethnicity, acculturation, and level of intelligence (Boone, Victor, Wen, Razani & Ponton, 2007; Diaz-Asper, Schretlen & Pearlson, 2004; Elst, Boxtel, Breukelen, & Jolles, 2005; Heaton, 2004; Manly, 2005; Norman et al., 2011; Patton et al., 2003; Rosselli & Ardila, 2003). In Scandinavian clinical practice and research, it is common to use neuropsychological tests from the United States. For example, when assessing executive functions and learning and memory functions, 85–87% of Scandinavian psychologists use neuropsychological tests that rely on U.S. normative data (Egeland et al., 2016). However, there are differences between Scandinavian countries and the United States on variables that might be related to cognitive test performance, such as the organization of compulsory schooling and access to higher education (Statistics Norway, 2018a; Telhaug, Mediås & Aasen, 2006), literacy rates (OECD, 2013; Sulkunen & Malin, 2017), access to healthcare (OECD, 2017), distribution of wealth and income (Wilkinson & Pickett, 2009), and racial and ethnic compositions of the population (Statistics Norway, 2018b; U.S. Census Bureau, 2017a). Therefore, using U.S. normative data with Scandinavian research participants and clinical patients might yield results that are inaccurate and misleading. If research is used to guide clinical practice in those with cognitive impairment, such as people with severe and persistent mental illness, it is important to understand the implications of using different normative systems. When reviewing the literature, we found that it was common not to address the possible relevance of the issues mentioned above (e.g. Anda et al., 2016; Helle et al., 2014; Hellvin et. al, 2012; Landrø, Fors, Våpenstad, Holte & Stiles, 2013; Simonsen et al, 2011). The possible effects of sociodemographic differences on the interpretation of neuropsychological test scores derived from normative data from another country might be important to highlight in further studies.

Cognitive impairment is a core clinical feature of the schizophrenia spectrum disorders (Kahn & Keefe, 2013). It is well established that people with schizophrenia spectrum disorders, on average, perform 1–2 standard deviations below the general population on neuropsychological tests (Gold, Queern, Iannone & Buchanan, 1999; Gogos, Joshua, & Rossell, 2010; Iverson, Brooks & Haley, 2009; Keefe, 2014; Sponheim et al., 2010; Wilk et al., 2004; Zhang et al., 2015).

Comorbid substance abuse is common among people with schizophrenia spectrum disorders. Recent population-based surveys in the U.S. estimated prevalence rate of substance abuse to 27% among patients with schizophrenia spectrum disorders (Kessler et al., 2005). In Norway, overall prevalence among patients with schizophrenia spectrum disorders is estimated to 25% but is higher for patients in their mid-20s: 43.5% among men and 30.3% among women (Nesvåg et al., 2015). 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).

The severity of 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 (Rajji, Miranda & Mulsant, 2014; Rosenheck et al., 2006). 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 and severity of cognitive deficits have implications for educational and vocational planning (Hoffmann et al., 2003).

The purpose of this paper is to illustrate and quantify how using different normative systems influences the accuracy of identifying cognitive impairment in people with schizophrenia spectrum disorders. Because Scandinavian normative mean scores for most RBANS subtests are higher than the U.S normative means (Randolph, 2013, manual, p. 31; Randolph, 2006, RBANS Supplement 1, p. 2), applying U.S. norms to Norwegians with schizophrenia spectrum disorders should yield higher test scores compared to applying Scandinavian normative data. We hypothesize that patients with comorbid substance abuse will have lower scores than those not abusing substances.

Method

Participants

A convenience sample of 315 patients, referred for neuropsychological assessment from psychiatric inpatient 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. Patients with psychotic symptoms due to known affective disorders were excluded. Patients of immigrant parents were included, if born and educated in Norway, but race and ethnicity were not recorded. Patients not born or educated in Norway were excluded (n = 24). Comorbid substance abuse was recorded in 128 (40.6%). Severity of symptoms, medication use, and illness severity were not recorded; nor were type and duration of substances abused. 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 304 registered diagnoses classified according to The International Statistical Classification of Diseases and Related Health Problems–10 (World Health Organization, 1992). The majority of patients had diagnoses of schizophrenia disorders (F20.0–F20.9) and schizoaffective disorders (F25.0–F25.9), accounting for 49.3%. Of those, 48.7% had F20.0 paranoid schizophrenia, 27.3% had schizoaffective disorders, and 10.7% had undifferentiated schizophrenia (F20.3). Paranoid psychosis or acute psychosis was diagnosed in 23.0% (F22.0–F23.9). Psychotic disorder due to substance abuse (F1x.5) was diagnosed in 16.4%. A minority were awaiting diagnostic decision (11.2%), having a diagnosis of hallucinations (R44.0–44.8) or strange and inexplicable behavior (R46.2).

The subjects ranged between 18–38 years, with a mean age of 24.33 years (*SD* = 4.92). Years of education ranged from 9–18 years, with a mean of 12.30 years (*SD* = 1.80). There were more men than women, 195 (61.9%) and 120 (38.1%), respectively. A subset of the participants (*n* = 81) completed the Norwegian version of Wechsler Adult Intelligence Scale-Fourth Edition, which applies Scandinavian norms collected in 2010 in Denmark, Norway, and Sweden (Wechsler, 2012). They had a mean Full Scale IQ (FSIQ) of 84.20 (*SD* = 12.68, Range = 62–118).

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 and has two alternative forms (A and B). Five age-corrected Index scores and a Total Scale are obtained from twelve subtests. Immediate Memory Index is comprised of List Learning and Story Recall, Visuospatial/Constructional Index of Figure Copy and Line Orientation, Language Index of Picture Naming and Fluency, Attention Index of Digit Span and Coding, and Delayed Memory Index of List Recall, List Recognition, Story Recall, and Figure Recall. The Total Scale score is derived from the sum of standard scores obtained on the five indexes. The Scandinavian normative sample (N = 454) ranges in age from 20–89, divided in the following age groups: 20–39 (*n* = 159), 40–49 (*n* = 65), 50–59 (*n* = 48), 60–69 (*n* = 73), 70–79 (*n* = 79) and 80–89 (*n* = 30). The normative sample was recruited by a professional survey bureau, matched for each country to the census percentages for sex, age, and education level. Whether ethnic composition was matched as well is not stated. In total, 234 women and 220 men participated. The Scandinavian normative sample includes adults from Denmark (*n* = 166), Norway (*n* = 137), and Sweden (*n* = 150). The education levels are secondary school (*n* = 78), high school (*n* = 165), two to four years at college or university (*n* = 127), and more than four years at college or university (*n* = 81). Of the entire sample, 45.8% had continued their education after completing high school, 36.8% had completed high school and 17.4% had less than high school. Of the 137 Norwegians, 35.0% had education at high school level or less, 65.0% had two or more years at college or university; 6.6% had secondary school as their highest educational attainment (Randolph, 2013, manual, p. 29–30). The current educational attainment of the Norwegian population is 63.6% at high school level and 33.4% with 2 or more years at college or university (Statistics Norway, 2018c). The Swedish and Danish participants had a more representative educational attainment level, which is comparable to the general Norwegian population education levels (Statistics Denmark, 2017; Statistics Sweden, 2018). Overall, the group with the highest educational attainment performed significantly better than those with the lowest educational attainment on the Immediate Memory, Attention and Total Scale Indexes (Cohen's *d* was .45, .39 and .42, respectively). There were no other significant differences when comparing different educational attainment levels (Randolph, 2013, manual, p. 33). The normative tables are stratified for age groups only. The age group of 20–39 years was comprised of 52 Norwegians, 44 Swedes, and 63 Danes (Randolph, 2013, manual, p. 29–30). Whether there were differences in test performance between Danes, Norwegians and Swedes is not reported. There are no differences in test material or the administration procedures between the Scandinavian manuals, other than translations in Norwegian, Swedish, and Danish (Randolph, 2013, manual, p. 22–23).

The U.S. normative sample (N=540) had 90 participants in each age group, matched to the U.S. Census percentages for sex, education levels (less than or equal to high school, high school, and greater than high school), and race/ethnicity (Whites, African Americans, and Hispanics). The sample corresponds closely to the census proportions of these variables reported in the Population Survey of March 1995. There were slightly more males (46.5%) in the normative sample, compared to the census (45.2%). Regarding race, 82.8% were identified as White, 10.1% as African-American, and 7.1% as Hispanic. The geographic regions specified by the Census report is North East, North Central, South, and West, and the corresponding census proportions are 20.2%, 23.6%, 35.6% and 20.5%. The standardization sample percentages are 7.0%, 62.4%, 23.7% and 6.9%, respectively. Analysis of Variance using RBANS Total Scale Index score as dependent variable and geographical region as dependent did not reveal any significant regional differences (Randolph, 1998, manual, p. 31–32). Of the entire sample, 45.1% had continued their education after completing high school, 20.1% had completed high school and 34.7% had less than high school (Randolph, 1998, manual, p. 33–34). Educational effects on test performance are not reported, nor are other potential group differences. The normative tables are stratified for age groups only.

There are some notable differences between the U.S. and the Scandinavian versions of the RBANS. To calculate the Index Score for the Verbal Index in the U.S., four points are added to the raw score of the Verbal Fluency Test of Form B to make the stimulus materials equivalent with Form A (Randolph, 1998, manual, p. 20 & 36–37), then the Language Index is tabulated from the single norm table. In a deliberate attempt to make the two Verbal Fluency Categories more similar in the Scandinavian versions, the category in Form B was changed from *animals in a Zoo* to *any animal* (Randolph, 2013, manual, p. 24). All participants in the Scandinavian normative sample were administered both forms, and separate norm tables for the Language Index for Form A and B were developed (Randolph, 2013, manual, p. 26). For the Coding test, the Scandinavian instructions elaborate in more detail the task of substituting the symbols with the numbers given in the key, compared to the U.S. instructions. The Scandinavian equivalent of the U.S. instruction of *"Go as quickly as you can…"* is omitted. No rationale is provided in the manual. For the Figure Copy tests and Figure Recall tests the Scandinavian scoring of item 8 (outside cross) are more lenient for both Form A and Form B. The U.S. scoring instruction is: *"Placement: horizontal line of outside cross touches rectangle higher than ⅔ height of rectangle…"*, whereas in the Scandinavian version this is altered to *"Placement: horizontal line of outside cross touches upper ⅔ of rectangle…"* No rationale is given. For Story Memory and Story Recall, the geographical locations are adapted. For example, *"…in Cleveland, Ohio…"* is changed to *"…in Lillehammer, Oppland…"* in the Norwegian version.

Procedure

Each patient was administered the RBANS using the standardized procedure in the Norwegian version. For the Coding test we added the Norwegian equivalent of *"Go as quickly as you can"*. Form A was administered to 172 (54.6%), Form B to 143 (45.4%). The average number of words produced for Scandinavians in the age group of 20–39 years for Form A (fruits and vegetables) and for Form B (animals) is presented in Table 1, as is the average of number of words produced for the U.S. sample. U.S. data are derived from Form A only (Randolph, 1998, manual, p. 37). In our current sample the mean raw scores were 15.92 (SD = 4.24) for Verbal Fluency Form A (n = 172) and 18.69 (SD = 5.71) for Verbal Fluency Form B (n = 143). An independent t-test revealed a significant difference, $t(257.08) = 4.80$, $p < .001$. Subtracting 3 from the raw score of Verbal Fluency Form B equated the raw scores (Form B M = 15.69, SD = 5.70) and the difference between the versions was no longer significant [$t(257.08) = -.41$, $p = .69$)]. Therefore, the U.S. scores for the Language Index for patients that were administered Form B were calculated after subtracting 3 from the Verbal

Fluency raw score to avoid an inflation of the U.S. Verbal Index Score for Form B compared to Form A. For Figure Copy and Figure Recall we used U.S. scoring criteria. The Scandinavian scoring criteria would have benefited nine patients in this sample.

[Insert Table 1 Here]

Results

Descriptive statistics (e.g., mean, median, and standard deviation) for the age adjusted standard scores were computed for the entire clinical sample and are presented in Table 2. There were no significant differences between those abusing substances compared to those not abusing substances using Scandinavian normative data (*p*-values ranging from .26–.97). Using U.S. normative data, those abusing substances scored significantly higher on the Language Index (M = 85.38, *SD* = 12.91) than those not abusing substances (M=81.71, *SD* = 14.78), $t(313) = -2.34$, $p = .020$). A chi-square goodness-of-fit test indicated that there was no significant difference in the proportions of Form A (44.5%) as compared with Form B (55.2%) in the group of substance abusing patients, χ^2 (1, $n = 128$) = 1.53, $p = .216$. For those not abusing substances, the difference in the proportions between Form A (61.5%) and Form B (38.5%) was significant, χ^2 (1, $n = 187$) = 9.89, $p = .002$.

As seen in Table 2, there were statistically significant differences between the Immediate Memory, Visuospatial/Constructional, Language, Delayed Memory, and Total Scale Index scores when comparing the U.S. normative scores to the Scandinavian normative scores. The effect sizes were medium for all index scores except for the Attention Index score. The patient sample scored higher when using the U.S. normative data, suggesting less cognitive impairment. We defined cognitive impairment has having 2 or more (out of 5) index scores $\leq 5^{th}$ percentile (Holdnack et al. 2017; Iverson, Brooks & Young, 2009a; Iverson, Brooks & Young, 2009b; Iverson, Brooks, Langenecker & Young, 2011). Using the U.S. normative data, 42.2% of the patients met criteria for impairment compared to 62.5% using the Scandinavian normative data [χ^2 (1, N = 315) = 99.49, $p < .001$, $\phi = .569$]. There was moderate agreement in classification between the two normative data sets [$\kappa = .523$ (95% CI, .439 to .608), $p < .001$], with an overlap of 94.1% of those classified as not impaired, and 64.0% overlap of those classified as impaired.

We compared the classification of impaired versus not impaired across the two normative data sets for substance abusers and non-abusers, men and women, those older than 28 years of age ($n = 68$) and those 28 years or younger ($n = 247$), those with less than high school (< 13 years of education, $n = 184$) and those with high school or more than high school (13 years of education or more, $n = 131$). We found that the U.S. norms classified significantly more women as impaired compared to men [χ^2(1, N = 315) = 9.08, $p < .002$, $\phi = .176$], whereas Scandinavian norms did not [χ^2 (1, N = 315) = 1.14, $p < .286$, $\phi = .067$].

Both the U.S. norms and Scandinavian norms classified more patients with less than high school as impaired compared to those with education at high school level or more [U.S.: χ^2 (1, N = 315) =10.22, $p = 001$, $\phi = -.187$; Scandinavian: χ^2 (1, N = 315) = 13.28, $p < .001$, $\phi = -.212$]. Comparing those older than 28 years of age with those 28 years or younger, the Scandinavian norms classified more of the older patients as impaired [χ^2 (1, N = 315) = 7.96, $p = .005$, $\phi = .167$], whereas the U.S. norms did not [χ^2 (1, N = 315) = .00, $p < .936$, $\phi = .005$]. No other differences were found.

We further investigated whether there was any demographic differences of those patients classified as not impaired by both norms ($n = 111$), as impaired by both norms ($n = 126$), those classified as impaired by the Scandinavian norms but not by the U.S. norms ($n = 71$), and those classified as impaired by the U.S. norms but not by the Scandinavian norms ($n = 7$). There were no differences in either group when comparing substance abusers to those not abusing substances [χ^2 (3, N = 315) = 1.34, $p = .719$]. There were significantly more patients with lower education classified as impaired and significantly more patients with higher education classified as not impaired for both normative sets [χ^2 (3, N = 315) = 16.63, *p* = .001]. Comparing age, significantly more of the younger patients were classified as not impaired by both normative sets. There was no difference in age for those patients classified as impaired by both sets. Scandinavian norms classified significantly more of those in the older group as impaired, compared to those classified as impaired by the U.S. norms. For those classified as impaired by U.S. norms only, all were in the younger group [χ^2 (3, N = 315) = 12.61, *p* = .006]. There were more women than men in the group classified as impaired by both normative sets [χ^2 (3, N = 315) = 11.58, *p* = .009].

We compared the difference between men and women for all indexes for both normative sets, using an independent t-test. We found that for Scandinavian norms men scored significantly higher on the Immediate Memory Index (M = 80.02, *SD* = 19.82) than women (M = 74.98, *SD* = 21.01), t(240.76) = 2.11, *p* = .036 and on the Visuospatial/Constructional Index [M_{men} = 88.72, SD_{men} = 16.04; M_{women} = 81.91, SD_{women} = 19.04, t(219.84) = 3.27. *p* = .001]. Men also scored higher on Total Scale (M = 70.47, *SD* = 18.23) compared to women (M = 65.49, *SD* = 19.54, t(238.63) = 2.25, *p* = .023). For U.S. norms, men likewise scored significantly higher than women on the Immediate Memory Index [M_{men} = 87.85, SD_{men} = 15.86; M_{women} = 83.71, SD_{women} = 19.04, t(313) = 2.15. *p* = .035], Visuospatial/Constructional Index [M_{men} = 96.77, SD_{men} = 17.93; M_{women} = 91.78, SD_{women} = 19.18, t(239.03) = 2.30, *p* = .022] and Total Scale [M_{men} = 81.50, SD_{men} = 14.00; M_{women} = 74.90, SD_{women} = 13.87, t(313)= 4.07, *p* < .001]. Men also scored higher on the Language Index (M = 85.02, *SD* = 13.92) compared to women (M = 80.25, *SD* = 14.08); t(313) = 2.93, p = .004, and had a higher score on the Attention Index (M = 72.16, *SD* = 15.02) than women had [M = 65.95, *SD* = 16.10, t(238.60) = 3.41, *p* < .001].

An independent t-test revealed a significant difference, t(313) = −2.64, *p* = .009, for the U.S. Language Index when comparing Form A (M = 81.30, *SD* = 14.30) to Form B (M =

85.49, *SD* = 13.66), but not for the Scandinavian norms [$M_{\text{Form A}}$ = 77.77, $SD_{Form\ A}$ = 16.13; $M_{\text{Form B}}$ = 76.95, $SD_{From\ B}$ = 19.94, t(271.78) = .40, p = .686]. We compared the Language Index scores derived from Form A (*n* = 172), using a paired samples t-test. We found that the difference between the two normative sets was less, but still significant [U.S. Language Index: M = 81.30, *SD* = 14.3; Scandinavian Language Index: M = 77.77, *SD* = 16.13, t(171) = −5.32, $p < .001$, Cohen's *d* = .22]. Comparing indexes derived only from Form A, the U.S. normative data classified 38.4% of the patients as impaired according to our definition, compared to 60.5% using the Scandinavian normative data [χ^2 (1, *n* = 172) = 57.25, $p < .001$, ϕ = .589]. There was moderate agreement in classification between the two normative data sets [κ = .534 (95% CI, .423 to .646), $p < .001$], with an overlap of 97.1% of those classified as not impaired, and 62.5% overlap of those classified as impaired.

[Insert Table 2 Here]

Discussion

Neuropsychologists in European countries often rely on normative data from the U.S., especially when good quality normative data for particular tests are not available in their home country. This study demonstrated that applying U.S. normative data to a large Norwegian sample of patients with schizophrenia spectrum disorders led to substantial differences in Index scores and Total Scale scores on the RBANS, compared to applying Scandinavian norms. The results have important clinical implications. If a neuropsychologist defined cognitive impairment on the RBANS as having two or more index scores $\leq 5^{th}$ percentile, a substantially greater percentage of patients with schizophrenia spectrum disorders would be classified as impaired using the Scandinavian normative data compared to the U.S. normative data. One in five patients would be classified differently (i.e., approximately 20%). If neuropsychological impairment in the present sample were based upon the U.S. norms, and if that assessment were used to guide treatment planning and vocational and educational planning, about 20% of patients would have had plans that would probably overshoot their capabilities. For those patients, risk of failure in meeting planned goals would probably be greater. Such failures are costly and demoralizing. Hoffmann et al. (2003) found that fatalistic control beliefs have predictive value for vocational functioning and rehabilitation for patients with schizophrenia. They consider resignation, sense of disempowerment and despair, along with cognitive deficits, as important targets for rehabilitation programs.

It is well established that people with schizophrenia spectrum disorders perform poorly on neuropsychological testing in general (Keefe, 2014; Sponheim et al., 2010), and on the RBANS in particular (Anda et al., 2016; Dickerson et al., 2004; Gogos et al., 2010; Gold et al., 1999; Helle et al., 2014; Iverson et al., 2009; Wilk et al., 2004; Zhang et al., 2015). Their performance on the RBANS Index scores tends to be, on average, 1.5–2 standard deviations below the mean (Anda et al., 2016; Dickerson et al., 2004; Gogos et al., 2010; Gold et al., 1999; Helle et al., 2014; Iverson et al., 2009; Wilk et al., 2004; Zhang et al., 2015). Iverson and colleagues (2009) reported RBANS scores for 174 inpatients with schizophrenia spectrum disorders at a provincial psychiatric hospital in Canada (using U.S. norms), and their mean index scores were similar to the scores obtained by the present sample using the Scandinavian normative data. The Scandinavian mean index scores were also more similar to those reported for patients with schizophrenia spectrum disorders by Dickerson et al. (2004), Gold et al. (1999), and by Wilk et al. (2004), compared to the index scores obtained when using U.S. normative data. Further, studies in Norway of other patient groups (Anda et al., 2016; Helle et al., 2014) have reported RBANS scores using U.S. norms and these scores were more similar to the scores derived from the U.S. norms in this sample. Interestingly, RBANS scores reported for patients with schizophrenia in Australia (Gogos, Joshua, & Rossell, 2010) were more similar to the scores derived for the U.S. norms, but the matched healthy controls in that study also had higher mean scores than the U.S normative means, in line with previous findings in Australia (Green et al., 2008).

Healthy adults in the Scandinavian normative sample (published in 2013) performed better on the RBANS compared to the U.S. normative sample (published in 1998). When comparing the demographic composition of the two normative groups, we found that the normative samples do not differ on demographic variables for sex. The normative samples are also quite similar in the percentages of participants with more than high school education. The U.S. normative sample has 34.7% with less than high school education, which is more than twice of the Scandinavian sample (17.4%). This difference is less pronounced in the age group of 20–39 years, where the U.S. normative sample had 54.5% participants with more than high school, 32.1% which had completed high school, and 13.2% with less than high school. Because educational levels across age groups are not reported in the Scandinavian manual, there might be important differences in educational attainment levels across age groups between the U.S. and Scandinavian normative samples. Education effects on performance on the RBANS have been reported (Beatty, Mold, & Gontkovsky, 2003; Cheng et al., 2011; Gold et al., 1999; Green et al., 2008; Patton et al., 2003; Randolph, 2013). Gontkovsky, Mold, and Beatty (2002) found that education was a significant and primary predictor of performance of all RBANS Indexes, and their results suggest that RBANS scores be adjusted for education. In the current sample, educational effects were found for both normative systems, indicating that level of education is associated with performance in our sample of patients with schizophrenia spectrum disorders.

The Scandinavian normative sample is probably less ethnically diverse than the U.S. normative sample. For example, in Scandinavian populations, the combined percentage of Hispanics and Africans are approximately 1.8% (Statistics Denmark, 2019; Statistics Norway, 2018b; Statistics Sweden, 2019), whereas the U.S. RBANS normative sample included a combined 17.2% of these two groups. Differences in RBANS performance associated with race have been published. Randolph (2012) found that U.S. Spanish-speaking citizens had a slightly lower performance of marginal significance on the Delayed Memory Index on the Spanish form A, when applying the U.S. normative data. Patton et al. (2003) found that healthy older African Americans scored significantly lower on 3 of 5 Index scores and the Total Scale score compared to Caucasians matched for age and education. Gold et al. (1999) reported that Caucasian patients diagnosed with schizophrenia score higher than African American patients on the Total Scale Index, but this difference disappeared when controlling for educational achievement. Even so, if we could compare the Scandinavian norms with normative data derived from a U.S. sample of a more similar ethnic composition as in Scandinavia, it cannot be ruled out that there would be less of a difference or none at all. Indeed, decades ago Kløve (1974) found that both healthy controls and patients with brain damage from Madison, Wisconsin—which have a rather large population of Scandinavian descent (U.S. Census Bureau, 2017b)—did not differ from healthy controls and patients with brain damage from Oslo, Norway, on the Halstead-Reitan Test Battery.

Men diagnosed with schizophrenia are reported to show more cognitive deficits, with greater structural brain and neurophysiological abnormalities, than women (Leung & Chue, 2000; Loughland, Lewin, Carr, Sheedy, & Harris, 2007; Szymanski, Lieberman, & Alvir, 1995). We note that the U.S. norms classified more women as impaired. Sex differences in performance on the RBANS are not reported for the U.S. or Scandinavian normative samples but have been reported in other samples. Duff, Schoenberg, Mold, Scott, and Adams (2011) found that for healthy older individuals from Oklahoma, U.S., women scored higher than men on the Language Index and Delayed Memory Index, whereas men scored higher on the Visuospatial/Constructional Index. For schizophrenia spectrum patients, Iverson et al. (2009) reported that men scored significantly higher than women on the Visuospatial/Constructional

Index, and there was a trend towards women performing better on Language, Attention, and Delayed Memory Indexes. Wilk et al. (2004) likewise found that men scored higher on Visuospatial/Constructional and Attention Indexes, and women higher on Delayed Memory Index. Gold et al. (1999) found that men scored higher than women only on the Visuospatial/Constructional Index. In contrast, Gogos et al. (2010) found no sex differences when specifically investigating for sex differences in samples of healthy controls and clinical groups of patients diagnosed with bipolar disorder or schizophrenia. In the current sample, men scored significantly better than women on Immediate Memory and Visuospatial/Constructional Indexes and Total Scale for both normative sets, and in addition on Language and Attention Indexes for the U.S. norms. It seems that men scoring higher than women on the Visuospatial/Constructional Index might have been expected, whereas women not scoring better than men on any other indexes might suggests that men in the present sample are functioning somewhat better cognitively.

The severity of cognitive impairment is somewhat correlated with disease duration (Barder et al., 2013; Keefe, 2014; Rajji & Mulsant, 2014; Sponheim et al., 2010, Zhang et al., 2015), although studies have investigated how performance on the RBANS is related to disease duration. Wilk et al. (2004) found that older patients had significantly lower scores on the Language and Attention indexes. Zhang et al. (2015) found that the RBANS index scores declined considerably along with disease course, in particular for the Delayed Memory Index. In line with this, both normative sets classified more of the older patients as impaired, but the Scandinavian norms classified significantly more of the older patients as impaired compared to the U.S. norms.

When comparing differences between the U.S. indexes and Scandinavian indexes, the difference for Language Index is probably overestimated. Form B yielded significantly higher Language Index scores compared to Form A when using U.S. normative tables, which have skewed the U.S. Language Index towards higher scores. The difference between the normative sets when comparing the Language Indexes derived from Form A only, is probably a more accurate estimate. For the Attention Index, the U.S. norms should have yielded a lower Attention Index score for Scandinavians, because the U.S. normative sample outperforms the Scandinavian normative sample for both Digit Span and Coding tests, which comprise this index. This difference might partly be due to the omission of *"Go as quickly as you can…"* for the Scandinavian version of the Coding test, but this cannot have influenced the results in the current sample as much, because we included that particular emphasis for speed in our instructions to the patients. For the Digit Span test, the U.S. normative sample has on average better capacity for this particular task. The slightly lower performance of Scandinavians on the Digit Span test might be due to the frequency of two-syllable digits (Naveh-Benjamin & Ayres, 1986). Egner, Sütterlin, and Lugo (2016) found that for Norwegians, optimal performance on Digit Span Forward tests occurs when the frequency of two-syllable digits were 22.2%. The frequency of two-syllable digits on the RBANS Digit Span Form A are in average 31.8% for Swedes and 19.3% for Danes and Norwegians, compared to 9.1% for U.S. citizens. The frequency for Digit Span Form B is 34.1%, 21.6% and 8.0%, respectively. Enger et al. (2016) suggests that a balanced distribution of two-syllable digits in a forward digit span test should theoretically increase digit spans tests' comparability across languages.

Applying U.S. normative data for the RBANS in Norway seems to overestimate cognitive functions. Similarly, the U.S. normative data for the Wechsler Abbreviated Scale of Intelligence might overestimate IQ in Norwegians (Siqveland, Dalsbø, Harboe, & Leiknes, 2014). For the Norwegian version of the California Verbal Learning Test–Second Edition, which applies U.S. norms, healthy controls score on average higher than the U.S. normative means, suggesting overestimation of verbal learning and memory functions (Egeland et al., 2005; Simonsen et al., 2009; Westlye et al., 2012). Egeland et al. (2005) also found that

Norwegian healthy controls scored higher than the U.S. normative means on the Recognition Memory Test for words. For the California Computerized Assessment Package Standard Test Battery, they reported that men (but not women) scored significantly better than the U.S. normative sample (all men). For the Rey Complex Figure Test they found no difference between healthy controls' test scores and U.S. normative means. However, in Denmark, Vogel, Stokholm, & Jørgensen (2012) found that using U.S. normative data for the Rey Complex Figure Test might overestimate memory functioning among older adults. For the Behavior Rating Inventory of Executive Function Adult Version, although not at a performance-based neuropsychological test, but frequently used by neuropsychologists in Norway (Egeland et al., 2016), the U.S. norms underestimate the level of executive function symptoms (Løvstad et al., 2016).

In contrast, for the Wechsler Adult Intelligence Scale-Fourth Edition and for the MATRICS Consensus Cognitive Battery, it has been reported that U.S. norms do not differ substantially from Scandinavian norms (Lorentzen, Tubylewicz-Olsnes, Zhu, & Troland, 2014; Mohn, Sundet, & Rund, 2012). For the Rey Auditory Verbal Learning Test, healthy older adults in Denmark performed at the same levels as U.S. normative samples (Vogel, Stokholm & Jørgensen, 2012). There is also some evidence that the U.S. norms for the Color Word Interference Test from the Delis–Kaplan Executive Function System are applicable in Norway (Halleland, Haavik, & Lundervold, 2012).

Limitations

The lack of control groups is a limitation in this study. Ideally, control groups should be both U.S. and Norwegian healthy controls that are fully comparable demographically with each other and with the clinical sample. This would enable an investigation of the possible effects of sex, race/ethnicity, and education, which are unknown factors in the U.S and Scandinavian normative samples and in the clinical sample in the current study.

Another limitation is the heterogeneity of the sample. If the sample could have been divided into diagnostic subgroups, or stratified by illness duration, this would have enabled more precise comparisons with other studies. If substance-abusing patients could have been stratified by duration of abuse or divided in those experiencing withdrawal symptoms and those not having withdrawal symptoms, we could have investigated in more detail the effects of substance abuse in schizophrenia spectrum disorders.

Conclusions

Applying U.S. normative data for the RBANS in Norway seems to under-estimate cognitive deficits in Norwegians with schizophrenia spectrum disorders. According to Egeland et al. (2016), no comprehensive neuropsychological test battery for adults has been translated and adapted into any Nordic language in recent decades. We suggest that our findings add support to the necessity of developing Scandinavian norms when translating U.S. neuropsychological tests to the Scandinavian languages.

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Table 1. RBANS Subtest Means and Standard Deviations for normative samples in the United States and Scandinavia for the Age Group 20–39 years.

	United States (n = 90)		Scandinavia (n = 159)	
RBANS Subtests	Mean	SD	Mean	SD
List Learning	30.7	4.3	32.3	3.9
Story Memory	19.1	3.3	19.7	2.7
Figure Copy	19.1	1.3	19.5	1.3
Line Orientation	16.8	3.0	18.6	1.8
Picture Naming	9.6	0.7	9.8	0.5
Semantic Fluency Form A	21.6	3.7	22.4	5.3
Semantic Fluency Form B	–	–	26.3	5.5
Digit Span	11.7	2.5	10.4	2.2
Coding	56.5	8.8	54.8	9.4
List Recall	7.5	1.8	8.1	1.7
List Recognition	19.8	0.7	19.7	0.8
Story Recall	10.1	2.1	10.2	1.6
Figure Recall	16.1	2.9	17.0	2.8

Note: RBANS = Repeatable Battery for the Assessment of Neuropsychological Status.
SD = Standard Deviation.
United States means and SDs are from RBANS Supplement 1 (Randolph, 2006, p. 2).
Scandinavian means and SDs are from RBANS Manual (Randolph, 2013, p. 31).

Table 2. Comparing Performance Using United States and Scandinavian Normative Data in People with Schizophrenia Spectrum Disorders.

	United States Norms			Scandinavian Norms				
Index	M	Md	*SD*	M	Md	*SD*	*p*	Cohen's *d*
Immediate Memory	86.3	85.0	16.4	78.1	78.0	20.4	<.001	0.4
Visuospatial/Constructional	94.9	100.0	18.5	86.1	90.0	17.5	<.001	0.5
Language	83.2	82.0	14.1	77.4	78.0	17.9	<.001	0.4
Attention	69.8	68.0	15.7	69.5	70.0	19.6	.620	0.0
Delayed Memory	85.5	91.0	18.1	78.6	80.0	20.6	<.001	0.4
Total Scale	79.0	80.0	14.3	68.6	69.0	18.9	<.001	0.6

Note: M = Mean; Md = Median; SD = Standard Deviation.