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Diagnostic Interview for Genetic Studies: Validity and Reliability of the Croatian Version

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Abstract

Objective—To test the validity and reliability of the Diagnostic Interview for Genetic Studies (DIGS) in patients with mental illness in Croatia.

Methods—Following translation, back-translation and pilot-testing, the Croatian version of DIGS (CRO-DIGS) was administered to a total of 150 inpatients and outpatients diagnosed at the Clinical Hospital in Split, with Bipolar and Major depressive Disorder (n=56), Schizophrenia and Schizoaffective disorder (n=62), and Alcohol dependence or use disorders (n=32). Initial testing was performed independently by one interviewer and one observer blinded to the diagnosis, and a retest was conducted after eight weeks by a third examiner.

Results—Validity of CRO-DIGS was high (κ = 0.916) with an excellent inter-rater (κ = 0.824) reliability, especially for Bipolar disorder (κ = 0.956). Following an eight week test-retest interval, the reliability for all diagnoses was found to be excellent (κ = 0.843).

Conclusions—Our study has shown excellent validity and reliability of the Croatian version of Diagnostic Interview for Genetic Studies, making it a promising instrument to assess mental

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illness of patients. The development of a valid and reliable diagnostic tool such as the CRO-DIGS will greatly advance the scientific communities' ability to conduct genetic studies of psychiatric illness in the region.

Keywords

DIGS; mental illness; validation and reliability; Croatia

Introduction

The development of common psychiatric disorders depends on the interplay of genetic and environmental influences (Geschwind and Flint, 2015). Over the last decade, large-scale genetic studies of psychiatric disorders revealed a complex genetic architecture with hundreds of risk-alleles underlying pathophysiology. For example, in schizophrenia, recent genome-wide association studies (GWAS) have implicated 108 loci (Schizophrenia Working Group of the Psychiatric Genomics Consortium, 2014), but little is known about the causative variants. In Bipolar disorder, a more heritable psychiatric illness, GWAS on several thousand cases and controls detected common variants at 14 genomic loci (Goes, 2016). Furthermore, next generation sequencing studies (exome or whole genome sequence) showed that, in addition to common variants identified in GWAS, rare variants also play an important role (Geschwind and Flint, 2015; Neale and Sklar, 2015). Interestingly, the frequency of these rarer alleles vary significantly among different populations (Auton et al., 2015; Lek et al., 2016). Therefore, strategies for prioritization of genetic variants identified by GWAS and next-generation sequencing studies will include the enrollment of a large number of subjects across many populations.

For mental illness, diagnosis still relies on symptoms, derived from observations by the clinician and self reports from the patient. Updated and refined versions of the International Statistical Classification of Diseases of Mental and Behavioral Disorders (ICD10) (World Health Organization, 1992) and the Diagnostic and statistical manual of mental disorders (DSM-5) (American Psychiatric Association, 2013) provide improved diagnostic reliability and are widely used by clinicians worldwide. Consistent with a need for a uniform and standardized method for phenotypic assessment of subjects with psychiatric illness and their family members, there are efforts to translate (in many languages) a set of polydiagnostic tools that may better reflect common pathophysiological mechanisms across mental diseases.

In 1994, collaborators at the National Institute for Mental Health Genetic Initiative developed the Diagnostic Interview for Genetic Studies (DIGS), a clinical interview construct for the assessment of major mood disorders, psychiatric disorders and their spectrum conditions (Nurnberger et al., 1994). This polydiagnostic assessment tool is particularly useful for genetic studies in families because a spectrum of different diagnostic categories is usually observed in probands and their relatives. The application of the DIGS also provides a detailed assessment of the longitudinal course of illness and the temporal relationship between psychotic or mood symptoms. Following the implementation of the DIGS in the USA (Nurnberger et al., 1994), other translations, validity and reliability testing

were performed by clinicians in several countries, including the Hindi version of the DIGS in India (Deshpande et al., 1998); French version of the DIGS in the Swiss population (Preisig et al., 1999); Spanish version in Colombia (Palacio et al., 2004) and in Spain (Roca et al., 2007); Korean version in Korea (Joo et al., 2004); and the Thai version in Thailand (Sitdhiraksa et al., 2008).

In an effort to develop an infrastructure for genetic studies of psychiatric disorders in Croatia, our team of clinicians and researchers translated the DIGS 3.0 version to the Croatian language. The goal of this study is to test the validity and reliability of the diagnoses of Schizophrenia, Bipolar disorder and Alcohol dependence using the Croatian version of DIGS (CRO-DIGS).

Material and methods

Study participants and ethical statement

This study included 180 participants with a previously confirmed ICD10 longitudinal diagnosis of Bipolar disorder, Schizophrenia, Alcohol dependence, Alcohol abuse, Major depressive disorder or Schizoaffective disorder. Of the 180 recruited participants, 12 subjects withdrew after the initial clinical evaluation and 18 subjects were not included in the final analysis due to incomplete data. All study participants were treated as inpatients or outpatients at the Clinic for Psychiatry at the Clinical Hospital in Split, Croatia. The Ethical Committee of the Medical School of the University of Split, Croatia approved this study, and all participants signed an informed consent form.

Procedure

Translation Process—The team consisted of six psychiatrists and a clinical coordinator who were fluent in both Croatian and English. They translated DIGS 3.0, including the instructions and questionnaire. During translation, members of the team made sure to use a uniform and consistent terminology and phrases. Once translation was completed, the questionnaire was applied to 10 subjects to permit further adjustments in terminology and cultural or historical context (e.g. inclusion of a question regarding exposure to the Croatian war of Independence). The Croatian translation was subsequently back-translated by an individual who was bi-lingual (Croatian and English) and was not involved in the initial translation. The back-translation and the initial DIGS version were compared by native English speakers familiar with DIGS 3.0 (JN & CF) and a bi-lingual Croatian-English speaker (MB). A few additional alterations were made during the comparison of translation and back-translation.

Standardization Process—Before standardization of the CRO-DIGS version, an experienced psychiatrist trained three other psychiatrists and four medical/graduate students in the correct application of the DIGS. In the pilot-testing phase, members of the team alternated between the roles of subject, interviewer and observer. After this stage, they evaluated subjects in specific diagnostic groups and then discussed the techniques used in the interview and their disagreements in scoring. An experienced psychiatrist, prior to administering an unstructured clinical interview, consulted available records (previous

medical documentation or information given by relatives, findings of psychological testing, notes from nurses and lab results) and gave a diagnosis in accordance with ICD-10.

Next, inter-rater and test-retest reliability of the CRO-DIGS was evaluated. The CRO-DIGS interviews were performed by an interviewer in the presence of an observer. All interviewers and observers were blinded to the recruitment source (i.e. specialty clinic) and referral diagnosis of the subject (i.e. the interviewees were told not to share their diagnosis). The interviewer and observer simultaneously and independently filled out the DIGS questionnaire and established the DIGS diagnosis. After 8 weeks, a retest was performed by a third interviewer who did not participate in the first interview and was blind to the results of DIGS testing by the previous interviewers. The roles of the interviewer and observer (during the first interview) and the retester (in the second interview) were divided among members of the team. Each DIGS interview lasted between two to four hours depending on the symptom complexity exhibited by the subject.

Statistical analysis

For the analysis of inter-rater and test-retest reliability we constructed 6 × 6 tables for the following diagnostic categories: Bipolar disorder, Schizophrenia, Alcohol dependence, Alcohol abuse, Schizoaffective disorder and Major depressive disorder. The consistency and concordance of diagnosis was calculated using Cohen's kappa coefficient (Cohen, 1960). In the case of psychiatric comorbidity, we calculated the kappa coefficient based on the first diagnosis. The validity of the diagnostic instrument was calculated by comparing the clinical diagnosis obtained using ICD10 and the CRO-DIGS. The same 6 × 6 table was used to calculate the overall kappa coefficient for inter-rater and test-retest reliability. According to Fleiss (Fleiss, 1981) the concordance is "excellent" when the kappas are above 0.75, "fair" to "good" for the values of kappa between 0.40 and 0.74, and "poor" when they are below 0.40. All statistical calculations were performed using SPSS Statistics Version 20 (Chicago, SPSS, Inc).

Results

The validity and reliability of CRO-DIGS was tested using 150 subjects, of which 82 (54.7%) were women and 68 (45.3%) were men. The youngest subject was 20 years old and the oldest was 70 years old, with an average age of 43.53 (±11.1) years. The majority of subjects (60.6%, n=91) were inpatients at the Psychiatric Hospital of Split, with an average of 4.91 (±7.2) hospitalizations; 16% (n=24) of subjects were not previously hospitalized. All study subjects were initially diagnosed by a clinician familiar with the ICD10 and DSM-IV diagnostic criteria. The 150 study participants come from six diagnostic categories: Bipolar disorder I and II (n=55), Schizophrenia (n=50), Schizoaffective disorder (n=12), Alcohol dependence (n=30), Alcohol use disorder (n=2) and Major depressive disorder (n=1).

We calculated the diagnostic validity of CRO-DIGS by comparing the ICD10 diagnosis criteria and diagnosis established based on the CRO-DIGS (according to the first interviewer) for all 150 subjects. Table 1 shows the kappa coefficient values for each diagnostic category. The overall validity was excellent with a kappa coefficient of 0.916. The validity is high for Bipolar disorder (κ = 0.942; 95% C.I. = 0.886–0.998), Schizophrenia (κ

= 0.955, 95% C.I. = 0.904–1), Alcohol dependence (κ = 0.956; 95% C.I. = 0.899–1), and Alcohol use disorder (κ = 0.797; 95% C.I. = 0.899–1), with a somewhat lower value for Schizoaffective disorder (κ = 0.715; 95% C.I. = 0.510–0.921) and Major depressive disorder (κ = 0.664; 95% C.I. = 0.007–1).

All 150 subjects were initially interviewed by an interviewer in the presence of an observer who provided independent DIGS scoring and diagnosis. The inter-rater (interviewer-observer) reliability is shown in Table 1. The overall reliability, established by a comparison of the CRO-DIGS diagnosis between interviewer and observer, was high (κ = 0.824). The inter-rater reliability was higher for Bipolar disorder (κ = 0.956; 95% C.I. = 0.908–1), Schizophrenia (κ = 0.848; 95% C.I. = 0.758–0.939) and Alcohol dependence (κ = 0.868, 95% C.I. = 0.765–0.972), and lower for Schizoaffective disorder (κ = 0.504; 95% C.I. = 0.246–0.762) and Major depressive disorder (κ = 0.493; 95% C.I. = 0–1). The inter-rater reliability was lowest for Alcohol use disorder (κ = 0.319; 95% C.I. = 0.000–0.977). The overall inter-rater reliability observed in our study is comparable to those reported by others (Table 2).

The overall test-retest reliability was determined by calculating the kappa coefficient based on the initial CRO-DIGS interview and the retester who performed the DIGS interview after 8 weeks. Table 1 shows values for kappa coefficient for test-retest reliability. Despite a significant time gap between the two interviews, the overall kappa coefficient for test- retest reliability (κ = 0.843) is equivalent to the overall kappa coefficient for inter-rater reliability (κ = 0.824). Similar to values obtained in the previous analysis, test-retest reliability kappa values for Bipolar disorder (κ = 0.913; 95% C.I. = 0.845–0.981), Alcohol dependence (κ = 0.912; 95% C.I. = 0.827–0.997) and Schizophrenia (κ = 0.892, 95% C.I. = 0.814–0.970) were higher, compared to values for the diagnosis of Major depressive disorder (κ = 0.664, 95% C.I. = 0.007–1), Alcohol use disorder (κ = 0.561; 95% C.I. = 0.070–1) and Schizoaffective disorder (κ = 0.532, 95% C.I. = 0.289–0.775) with a “fair” to “good” agreement.

Discussion

We have prepared and tested the Croatian version of DIGS (CRO-DIGS) on 150 patients with a range of psychiatric disorders. We report an overall high level of validity of this version (κ = 0.916) and an excellent test-retest (κ = 0.843) and inter-rater (κ = 0.824) reliability. We have followed a common procedure for testing the translated DIGS version, including a back translation that was approved by an expert who was familiar with the original (English) DIGS. The major difference between the original validation paper (Nurnberger et al., 1994), over 6 versions in other languages, and our report, may come from population specific differences in disease manifestation and in the inclusion criteria used in the selection of subjects.

The number of subjects across several diagnostic categories is comparable to those in other reports. An important aspect of our translation and testing is that due to the high similarity of the Croatian, Serbian, Bosnian and Montenegrin languages the instrument will require only

minor modifications to be used for genetic studies in additional countries in Southeastern Europe.

The main limitation of our study is the fact that the majority of participants were hospitalized and under medication during the initial interview, as medication may decrease the intensity of symptoms and change clinical presentation. However, we found high agreement between the CRO-DIGS-based diagnosis and the ICD10 diagnosis initially recorded in patients medical records in the majority of cases. Another limitation might be our combining of patients with Bipolar disorder I and Bipolar disorder II into a single diagnostic category, mainly because the number of available (or potential) Bipolar disorder II subjects was minimal.

Furthermore, our study did not include the application of CRO-DIGS to control subjects or subjects without diagnosed mental illness. Several other studies, including Nurnberger et al (Nurnberger et al., 1994); Preisig et al. (Preisig et al., 1999); Palacio et al. (Palacio et al., 2004); and Sitdhiraksa et al. (Sitdhiraksa et al., 2008) include control subjects. This is an important step because in genetic studies of families, non-affected relatives are often tested. Also, in the majority of previous reports, the validity was evaluated based on the concordance to the DSM IV criteria and the DIGS-based diagnosis. In contrast, in our report (and in the publication of the Hindi version) the validity is tested by comparing the ICD10 criteria and DIGS, as the ICD10 is standardly used in Croatia.

Our results show a high level of validity of CRO-DIGS in comparison to ICD10 diagnosis for Bipolar disorder, Schizophrenia, Alcohol dependence and Alcohol use disorder. The range of kappa coefficients ($\kappa = 0.66$ to $\kappa = 0.715$) for Alcohol use disorder, Major depressive disorder and for Schizoaffective disorder is less optimal, probably reflecting the lower number of subjects (one with Depression, two with Alcohol use disorder and 12 with Schizoaffective disorder). It is interesting that in the testing of the Hindi-version of DIGS, the concordance between the clinical diagnosis established by ICD10 and DIGS was lower ($\kappa = 0.56$). In general, other studies that compared the DIGS versions in different languages and the DSM-IV clinical diagnosis reported a higher level of concordance than the Hindi-study.

In our study, similar to other reports (Joo et al., 2004; Palacio et al., 2004; Preisig et al., 1999; Roca et al., 2007) the best reliability was reported for Bipolar disorder ($\kappa = 0.956$). Inter-rater reliability for Schizophrenia is also comparable to other reports ($\kappa = 0.848$), except in the Korean version (Joo et al., 2004), which is significantly lower ($\kappa = 0.60$). The original - English - version has been reported to be less reliable for Schizoaffective disorder (Nurnberger et al., 1994) ($\kappa = 0.39$). We assume that the low apparent prevalence of this diagnosis in Croatia may be the basis for the low level of inter-rater reliability ($\kappa = 0.504$). We also report a low inter-rater reliability for Alcohol use disorder ($\kappa = 0.319$) and Major depressive disorder; again attributable to the small number of subjects that precludes proper evaluation of the reliability of the CRO-DIGS for these disorders.

When comparing the test-retest reliability between different studies, it is important to take into account the time interval between the initial test and retest. We noticed that the range of

interval is 7–350 days in the Korean study, to a shorter interval (4–42 days) reported by others (Berney et al., 2002; Deshpande et al., 1998; Joo et al., 2004; Nurnberger et al., 1994; Palacio et al., 2004; Preisig et al., 1999; Roca et al., 2007; Sitdhiraksa et al., 2008). We selected a more uniform and longer interval of eight weeks, in an effort to establish a more stable diagnosis. Even with a longer time interval between the test and retest, we obtained uniformly high test-retest reliability across all diagnostic categories.

The high concordance of the validity and reliability of the CRO-DIGS with results reported in similar international efforts to validate the DIGS in multiple languages provides a solid foundation for future large-scale genetics studies in Croatia. Implementation of the CRO-DIGS will permit a combined analysis of disease-specific findings, as well as investigations of subtle differences in psychiatric and medical co-morbidities between Croatian and other populations. There are several unique aspects of studies of mental illness in Croatia, a small and apparently genetically heterogeneous country in Southeastern Europe. There are ongoing studies of several genetic isolates on Croatian islands that include investigations of a wide range of metabolic traits but lack investigations of mental illness (Rudan et al., 2009). Also, highly relevant to the mood disorders included in the DIGS, there is a high prevalence of suicide is some but not all parts of Croatia (Aleman and Denys, 2014; Sedic et al., 2003). The development of a valid and reliable diagnostic tool such as the CRO-DIGS will greatly advance the scientific communities ability to conduct genetic studies of psychiatric illness in this region.

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Table 1

Validity, inter-rater reliability, test-retest reliability of the Croatian version of the DIGS

	BP	SCZ	SA	ALD	ALA	MDD	Total
Validity (kappa)	0.942	0.955	0.715	0.956	0.797	0.664	0.916
95% C.I.	0.886–0.998	0.904–1	0.510–0.921	0.899–1	0.400–1	0.007–1	0.863–0.969
Number of subjects	55	50	12	30	2	1	150
Inter-rater reliability (kappa)	0.956	0.848	0.504	0.868	0.319	0.493	0.824
95% C.I.	0.908–1	0.758–0.939	0.246–0.762	0.765–0.972	0.0 –0.977	0–1	0.751–0.898
Number of subjects	53	49	15	28	3	2	150
Test - retest reliability (kappa)	0.913	0.892	0.532	0.912	0.561	0.664	0.843
95% C.I.	0.845–0.981	0.814–0.970	0.289–0.775	0.827–0.997	0.070–1	0.007–1	0.773–0.914
Number of subjects	53	49	15	28	3	2	150

Abbreviations: BP -bipolar disorder; SCZ-schizophrenia; SA-schizoaffective disorder; ALD-alcohol dependence; ALA- alcohol abuse; MDD- major depression; C.I.-confidence interval

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Table 2

Comparison of inter rater reliability (kappa coefficient)

	Nurnberger et al. (1994)	Deshpande et al. (1998)	Preisig et al. (1999)	Palacio et al. (2004)	Joo et al. (2004)	Berney et al. (2002)	Roca at al. (2007)	Sitdhiraksa et al. (2008)	Current study (2013)
Sample	**Outpatients**	**In/Outpatients**	**In/Outpatients**	**Outpatients**	**In/Outpatients**	**In/Outpatients**	**In/Outpatients**	**In/Outpatients**	**In/Outpatients**
n	179	20	136	91	24	133	91	203	150
Instrument	DIGS	DIGS	DIGS	DIGS	DIGS	DIGS	DIGS	DIGS	DIGS
Diagnostic criteria	DSM-III-R	DSM -IV	DSM -IV	DSM -IV	DSM -IV	DSM -IV	DSM -IV	DSM -IV	ICD- X
Overall kappa coefficient	0.78	-	0.87	-	0.79	0.98	0.956	0.89	0.824
kappa BP	0.78	-	0.85	0.87	1	-	0.903	0.83	0.956
kappa SCZ	0.73	-	0.87	0.81	0.60	-	1	0.92	0.848
kappa SA	0.39	-	0.69	0.37	0.50	-	1	-	0.504
kappa ALC.Dep.	-	-	-	-	1	0.79	-	0.90	0.868
kappa ALC. Abu	-	-	-	-	-	0.65	-	-	0.319
kappa MDD	0.84	-	0.93	0.86	0.83	-	0.877	0.80	0.493
kappa other dg.	0.87	-	-	0.65	-	-	1	-	-
kappa Control	0.87	-	1	0.65	-	-	-	0.92	-

Abbreviations: BP -bipolar didsorder; SCZ-schizophrenia; SA-schizoaffective disorder; ALD- alcohol dependence; ALA- alcohol abuse; MDD- major depression; Dg.-diagnosis

Table 3

Comparison of test retest reliability (kappa coefficient)

	Nurnberger et al.(1994)	Deshpande et al.(1998)	Preisig et al. (1999)	Palacio et al.(2004)	Joo et al. (2004)	Berney et al. (2002)	Roca at al. (2007)	Sitdhiraksa et al. (2008)	Current study (2013)
Sample	**Outpatients**	**In/Outpatients**	**In/Outpatients**	**Outpatients**	**In/Outpatients**	**In/Outpatients**	**In/Outpatients**	**In/Outpatients**	**In/Outpatients**
n	81	20	99	65	53	99	90	180	150
Instrument	DIGS	DIGS	DIGS	DIGS	DIGS	DIGS	DIGS	DIGS	DIGS
Interval (days)	4–10	7	42	42	7–350	42	28–42	31.4	56–72
Diagnostic criteria	DSM-III-R	DSM -IV	DSM -IV	DSM -IV	DSM -IV	DSM -IV	DSM -IV	DSM -IV	ICD- X
Overall kappa coefficient	0.85	0.45–1	0.60	0.80	0.82	0.72	0.926	0.78	0.843
kappa BP	0.96	-	0.63	1	0.74	-	0.903	0.85	0.913
kappa SCZ	0.75	-	0.72	0.87	1	-	1	0.85	0.892
kappa SA	0.31	-	0.40	0.84	0.43	-	0.846	-	0.532
kappa ALD.	-	-	-	-	-	0.73	-	0.70	0.912
kappa ALA	-	-	-	-	-	0.19	-	-	0.561
kappa MDD	0.94	-	0.59	0.92	1	-	0.776	0.65	0.664
kappa other dg.	-	-	-	0.65	-	-	1	-	-
kappa Control	0.86	-	0.65	0.88	-	-	-	0.73	-

Abbreviations: BP -bipolar didsorder; SCZ-schizophrenia; SA-schizoaffective disorder; ALD- alcohol dependence; ALA- alcohol abuse; MDD- major depression; Dg.-diagnosis