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Validation of the Italian version of the Northoff Catatonia Rating Scale

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Summary. Purpose. Catatonia is a psychomotor syndrome characterized by heterogeneous motor, behavioral and affective alterations, and, in some cases, neurovegetative abnormalities that can be life-threatening. Although the prevalence estimates of catatonia are 10-20% of the hospitalized population, its clinical recognition remains a challenge for most clinicians. Differently from other catatonia rating scales, the Northoff Catatonia Rating Scale (NCRS) also evaluates the affective alterations that patients experience during catatonia and thus provides a more inclusive assessment of the alterations associated with this condition. To provide clinicians with a valuable tool for diagnosis, we translated the NCRS in Italian and validated it on a sample of 52 hospitalized patients with psychiatric disorders. **Methods.** An Italian version of the NCRS was prepared using the forward-backwards translation from English and administered to a sample of 52 in-patients (age 46.9±2.37 years). The inter-rater reliability, score correlations, internal coherence and decision statistics were computed. **Results.** The inter-rater agreement was higher for the motor subscale (100% agreement) than for the behavioral (94%) or affective subscales (92.3%). The inter-rater agreement was 100% for the diagnosis of catatonia. The NCRS correctly identified all patients with catatonia according to DSM-5 (sensitivity= 100%) and had a specificity of 88.9%, and its subscale scores were highly inter-correlated. **Conclusions.** This validation shows that the NCRS yields a good accuracy in diagnosing catatonia and high inter-rater reliability. Moreover, the high correlation between its subscales supports the view that catatonia is a multi-faceted truly psycho-motor syndrome. In conclusion, the validation and Italian translation of the NCRS provides the clinicians with a helpful tool for diagnosing catatonia which is easy to use and assesses the full psychomotor complexity of the syndrome.

Key words. Bush-Francis Catatonia Rating Scale, catatonia, DSM-5, Northoff Catatonia Rating Scale, schizophrenia, validation.

Validazione della versione italiana della Northoff Catatonia Rating Scale.

Riassunto. Scopo. La catatonia è una sindrome psicomotoria caratterizzata da varie alterazioni della motricità, del comportamento e dell'affettività e, talvolta, da anomalie autonomiche potenzialmente letali. Nonostante la prevalenza della catatonia si attesti al 10-20% della popolazione ospedalizzata, il suo riconoscimento clinico permane difficoltoso. A differenza di altre scale di valutazione, la Northoff Catatonia Rating Scale (NCRS) valuta anche le alterazioni dell'affettività di cui possono avere esperienza i pazienti durante la catatonia, e quindi garantisce una valutazione più completa delle alterazioni associate a questa condizione. Abbiamo tradotto e validato la NCRS su un campione di 52 pazienti ospedalizzati per disturbi psichiatrici per fornire uno strumento affidabile per la diagnosi della sindrome. **Metodi.** Una versione italiana della NCRS è stata preparata con un processo di traduzione forward-backward dall'inglese e somministrata a 52 pazienti (età 46,9±2,37 anni). Sono state calcolate la concordanza inter-esaminatore, le correlazioni tra i punteggi, la coerenza interna e le statistiche del test. **Risultati.** La concordanza inter-esaminatore è risultata più alta per la sottoscala motoria (100%) rispetto a quella comportamentale (94%) o affettiva (92,3%). La concordanza per la diagnosi di catatonia è 100%. La NCRS ha identificato correttamente tutti i pazienti con catatonia secondo il DSM-5 – sensibilità 100% – e ha mostrato una specificità del 88,9%. I punteggi alle sottoscale sono altamente inter-correlati. **Conclusioni.** La NCRS ha una buona precisione diagnostica per la catatonia e alta concordanza inter-esaminatore. Inoltre, l'elevata correlazione tra i punteggi alle sottoscale supporta l'ipotesi che la catatonia sia una sindrome psicomotoria poliedrica. In conclusione, la validazione e traduzione della NCRS fornisce ai clinici un utile strumento per la diagnosi della catatonia che è semplice da usare e cattura la complessità psicomotoria di questa sindrome.

Parole chiave. Bush-Francis Catatonia Rating Scale, catatonia, DSM-5, Northoff Catatonia Rating Scale, schizofrenia, validazione.

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Introduction

Catatonia is a psychomotor syndrome that can be characterized by a wide range of motor, behavioral, and affective signs[1,2]. Although historically known for their association with schizophrenia, catatonic symptoms can be a feature of a variety of medical[3-5] and psychiatric disorders[6], or present as a syndrome *per se*[7]. The psychomotor alterations typical of catatonia are as prevalent as frequently under-recognized[8,9], especially in nonpsychiatric medical settings. Approximately 40 signs of catatonia have been described[10], which encompass the motor domain (e.g., stereotypies, waxy flexibility, immobility), the behavioral domain (e.g., automatic obedience, echo phenomena, grimaces), the affective domain (e.g., ambivalence, affective flattening or lability), and dysautonomic signs (temperature, blood pressure and heart rate variations) [2]. Given its epidemiological relevance – approximately 10% of the hospitalized population is affected by catatonia to some extent[11] and the possibility of effectively treating the condition when recognized, some rating scales have been developed to aid the clinician in diagnosing catatonia[11]. Most of these scales are based on the definition of catatonia as a purely motor-behavioural syndrome[12-15] (as also defined in the current and previous versions of the Diagnostic and Statistical Manual of Mental Disorders - DSM[16]), thus neglecting the aspects related to affective symptoms from the evaluation. For this reason, affective symptoms during episodes of catatonia had been little investigated with respect to hyperkinetic or hypokinetic motor manifestations, leading to a gap of knowledge regarding the symptoms experienced by patients[17]. To fill this gap, Northoff and colleagues[2] published and validated the Northoff Catatonia Rating Scale (NCRS). The NCRS is a clinician-administered scale that assesses 40 symptoms and signs of catatonia, grouped into three clusters: motor, behavioural and affective domains. Although NCRS could represent a fruitful standardized research tool for studying the affective symptoms of catatonia including its clinical diagnosis, its worldwide adoption has been mainly limited by the small number of validations in languages other than English[18]. Here, we wanted to partially address this issue by reporting the results of the Italian translation and validation of the NCRS.

Methods

Forward and back-translation

The process of back and forward translation, and semantic equivalence, was conducted according to the Sartorius et al.'s protocol[19]. Two independent translations into Italian were done by two bilingual researchers independently (DO, MS). The first translation was then back-translated into English by two other translators (FS, GP), and a third researcher assessed adequacy with the original scale (GP). Lastly, based on the two sets of translations and their suitability with the original version of the scale, a semantic and conceptual consensus was reached by the researchers and two psychiatrists (FS, DO, MS).

Validation of the scale

The Italian version of the Northoff Catatonia Rating Scale was then applied to patients (aged 18 years or more) admitted to the Psychiatric Inpatient Unit of the Psychiatric Clinic at Padua University Hospital, Italy, between July and September 2019. Two trained examiners (IR, AG) administered the rating scale and independently evaluated catatonic symptoms according to Fink's standardized criteria. A brief clinical interview followed the ratings to assess the affective symptoms experienced by the patients (IR, AG). After the clinical interview, the examiners compared their findings to what could be observed during clinical rounds to complete the assessment of symptoms that might not have manifested during the interview (e.g., autonomic instability, mutism). The validation of the scale included 52 patients, aged between 19 and 84 years (mean age±standard deviation, 46.9±2.37). The most represented diagnoses in this sample were mood disorders (48.1%), psychotic disorders (34.6%), or alcohol/substance use disorder (5.8%). More than 80% of the patients were receiving at least one antipsychotic medication, 73.1% benzodiazepines, 55.8% mood stabilizers and 44.2% antidepressants. There were no statistically significant demographic differences (at $p<0.05$) between the group of patients with catatonia and those without it (table 1).

Statistical analysis

Means were compared through t-Student tests for independent samples. The inter-rater reliability was assessed with Cohen's K. Correlations between the subscales of the NCRS, the total scale score and DSM-5 criteria or Bush-Francis Catatonia Rating Scale (BFCRS) were calculated through Kendall's τ. The internal coherence of the NCRS subscales and the total scale was computed through Cronbach's α. The prevalence, sensitivity, specificity, positive and negative predictive value, Youden's J Statistic, and positive and negative Likelihood Ratio were compared for the NCRS to the DSM-5 criteria and the BFCRS. The analyses were conducted using Jamovi 2019.

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Table 1. Sample characteristics.

	Northoff Criteria		DSM-5 Criteria	
	With catatonia	**Without catatonia**	**With catatonia**	**Without catatonia**
No. cases	12	40	7	45
Age [mean (SD)]	53.58 (16.63)	44.90 (16.95)	55.00 (16.15)	45.64 (17.09)
Diagnosis (%)				
Mood Disorders	6 (50.0)	19 (47.5)	4 (57.1)	21 (46.7)
Schizophrenia Spectrum Disorders	5 (41.7)	15 (37.5)	3 (42.9)	17 (37.8)
SUD/AUD	0 (0.0)	2 (5.0)	0 (0.0)	2 (4.4)
Other	1 (8.3)	4 (10.0)	0 (0.0)	5 (11.1)
Females [No. (%)]	6 (50.0)	21 (52.5)	4 (57.1)	23 (51.1)
Current treatment				
Any Mood Stabilizer (%)				
No	3 (25.0)	20 (50.0)	2 (28.6)	21 (46.7)
Yes	9 (75.0)	20 (50.0)	5 (71.4)	24 (53.3)
Any Antidepressant (%)				
No	5 (41.7)	24 (60.0)	4 (57.1)	25 (55.6)
Yes	7 (58.3)	16 (40.0)	3 (42.9)	20 (44.4)
Any Antipsychotic (%)				
No	0 (0.0)	9 (22.5)	0 (0.0)	9 (20.0)
Yes	12 (100.0)	31 (77.5)	7 (100.0)	36 (80.0)
Any Benzodiazepine (%)				
No	4 (33.3)	10 (25.0)	2 (28.6)	12 (26.7)
Yes	8 (66.7)	30 (75.0)	5 (71.4)	33 (73.3)

Legend: AUD= Alcohol Use Disorder; SUD= Substance Use Disorder; SD= standard deviation.

Ethical statement

All participants expressed their will to participate in the study and signed an informed consent form. This research was performed following the Helsinki Declaration of 1975 guidelines.

Results

We first compared the NCRS score of patients with catatonia (diagnosed with the DSM-5 criteria or according to the BFCRS) to patients without catatonia. Regardless of diagnostic criteria, patients with catatonia scored significantly higher in NCRS than patients without catatonia (table 2). Pertaining to the inter-rater reliability of the total NCR scale, subscales, and individual items, we show that the inter-rater agreement was higher for the motor subscale (100% agreement, Cohen's K=1, p<0.001) than for the behavioral (94% agreement, Cohen's K=.867, p<0.001) or affective subscales (92.3% agreement, Cohen's K=0.77, p<0.001). When considering the diagnosis of catatonia according to the NCRS (i.e., each subscale with a score >1 and a total score >7 to conclude on its presence vs absence), the inter-rater agreement was 100% (Cohen's K=1, p<0.001, table 3). Then, we analyzed the correlations between the NCRS and BFCRS or DSM-5 scores. In both cases, we observed a statistically significant correlation between the scales, irrespective of the rater examining patients for catatonic symptoms, with stronger correlations between NCRS and BFCRS than between NCRS or BFCRS and DSM (table 4).

According to the DSM-5 criteria, our sample consisted of 7 out of 52 patients with catatonia and 45 without it. NCRS correctly identified all patients with catatonia according to DSM (7/7, sensitivity= 100%) and considered five more patients, without catatonia according to DSM-5, to have the syndrome (i.e., five false positives, specificity= 88.9%). With a prevalence of catatonia of 13.4% in our sample (according to DSM-5), the positive predictive value of NCRS is 58.3%. The negative predictive value is 100%, with an overall accuracy of 90.4% and a Youden's J Statistic of 0.889 (see table 5A and 5B). On the other hand, according to the BFCRS score, 14 out of 52 patients in

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Table 2. Score differences between patients with or without catatonia.

Criteria: DSM-5

						95% Confidence Interval			95% Confidence Interval	
Examiner	**Subscale**	**t-test Statistic**	**df**	**p**	**Mean difference**	**Lower**	**Upper**	**Effect Size**	**Lower**	**Upper**
A	NCRS MA	-6.16	50.0	<0.001	-2.05	-2.71	-1.380	-2.50	-3.45	-1.542
	NCRS AA	-9.31	50.0	<0.001	-7.09	-8.62	-5.559	-3.78	-4.89	-2.651
	NCRS BA	-8.93	50.0	<0.001	-7.18	-8.80	-5.568	-3.63	-4.71	-2.519
	NCRS TOT	-10.84	50.0	<0.001	-16.30	-19.32	-13.278	-4.40	-5.61	-3.178
B	NCRS MA	-5.99	50.0	<0.001	-2.05	-2.73	-1.361	-2.43	-3.37	-1.479
	NCRS AA	-8.08	50.0	<0.001	-6.53	-8.15	-4.907	-3.28	-4.32	-2.223
	NCRS BA	-7.60	50.0	<0.001	-6.38	-8.07	-4.695	-3.09	-4.10	-2.054
	NCRS TOT	-9.66	50.0	<0.001	-14.96	-18.07	-11.850	-3.93	-5.06	-2.774
A	BFCRS TOT	-9.31	50.0	<0.001	-13.59	-16.52	-10.658	-3.78	-4.89	-2.651
B	BFCRS TOT	-9.11	49.0	<0.001	-13.86	-16.91	-10.800	-3.96	-5.13	-2.762
A	DSM TOT	-16.69	50.0	<0.001	-4.40	-4.93	-3.873	-6.78	-8.39	-5.151
B	DSM TOT	-14.37	50.0	<0.001	-4.48	-5.11	-3.853	-5.84	-7.28	-4.374
C	CGI-S	-2.75	50.0	0.008	-1.45	-2.51	-0.388	-1.12	-1.94	-0.280
A	NCRS MA	-4.33	50.0	<0.001	-1.252	-1.83	-0.6709	-1.353	-2.03	-0.6604
	NCRS AA	-8.91	50.0	<0.001	-5.365	-6.57	-41.547	-2.784	-3.66	-18.946
	NCRS BA	-9.13	50.0	<0.001	-5.575	-6.80	-43.489	-2.855	-3.74	-19.536
	NCRS TOT	-9.85	50.0	<0.001	-12.165	-14.65	-96.855	-3.080	-4.00	-21.414
B	NCRS MA	-4.70	50.0	<0.001	-1.350	-1.93	-0.7728	-1.469	-2.16	-0.7638
	NCRS AA	-7.63	50.0	<0.001	-4.898	-6.19	-36.098	-2.387	-3.20	-15.597
	NCRS BA	-8.73	50.0	<0.001	-5.211	-6.41	-40.114	-2.729	-3.59	-18.480
	NCRS TOT	-9.54	50.0	<0.001	-11.459	-13.87	-90.462	-2.983	-3.89	-20.601
A	BFCRS TOT	-9.47	50.0	<0.001	-10.523	-12.75	-82.905	-2.960	-3.86	-20.415
B	BFCRS TOT	-8.84	49.0	<0.001	-10.128	-12.43	-78.258	-2.841	-3.73	-19.300
A	DSM TOT	-7.47	50.0	<0.001	-2.673	-3.39	-19.546	-2.337	-3.14	-15.170
B	DSM TOT	-7.89	50.0	<0.001	-2.861	-3.59	-21.327	-2.467	-3.29	-16.275
C	CGI-S	-2.25	50.0	0.029	-0.932	-1.77	-0.0991	-0.703	-1.33	-0.0650

Legend: AA= Affective Alterations; BA= Behavioral Alterations; BFCRS= Bush-Francis Catatonia Rating Scale; CGI-S= Clinical Global Impression-Severity; df= degrees of freedom; DSM= Diagnostic and Statistical Manual of Mental Disorders; MA= Motor Alterations; NCRS= Northoff Catatonia Rating Scale; TOT= Total score.

Table 3. Inter-rater agreement for the single items of the NCRS (a Northoff Catatonia Rating Scale).

Item	Inter-rater agreement	Cohen's K	p
NCRS TOT	**100%**	**1**	**<0.001**
Motor Alterations	**100%**	**1**	**<0.001**
Mannerisms	100%	1	<0.001
Stereotypy	100%	1	<0.001
Festination	100%	1	<0.001

(*Continue*) **Table 3**

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(*Continue*) **Table 3.**

Item	Inter-rater agreement	Cohen's K	p
Athetotic Movements	100%	1	<0.001
Dyskinesias	100%	1	<0.001
Gegenhalten	100%	1	<0.001
Posturing	100%	1	<0.001
Catalepsy	96.2%	0.649	<0.001
Flexibilitas cerea	98.1%	0.66	<0.001
Rigidity	100%	1	<0.001
Muscular hypotonus	100%	1	<0.001
Sudden muscular tone alterations	100%	1	<0.001
Akinesia	98.1%	0.847	<0.001
Affective Alterations	**92.3%**	**0.77**	**<0.001**
Compulsive emotions	100%	1	<0.001
Emotional lability	100%	1	<0.001
Impulsivity	96.2%	0.84	<0.001
Aggression	98.1%	0.79	<0.001
Excitement	100%	1	<0.001
Affect-related behavior	98.1%	0.658	<0.001
Flat affect	82.7%	0.736	<0.001
Affective latence	94.2%	0.736	<0.001
Anxiety	80.8%	0.649	<0.001
Ambivalence	96.2%	0.779	<0.001
Staring	90.4%	0.779	<0.001
Agitation	67.3%	0.205	0.04
Behavioral alterations	**94%**	**0.867**	**<0.001**
Grimacing	100%	1	<0.001
Verbigerations	98.1%	0.892	<0.001
Perseverations	98.1%	0.901	<0.001
Increased, compulsive-like speech	96.2%	0.49	<0.001
Abnormal speech	90.4%	0.716	<0.001
Automatic obedience	96.2%	0.889	<0.001
Echolalia/praxia	94.2%	0.703	<0.001
Mitgehen/mitmachen	98.1%	0.658	<0.001
Compulsive behavior	98.1%	0.66	<0.001
Negativismus	96.2%	0.729	<0.001
Autism/Withdrawal	94.2%	0.845	<0.001
Mutism	100%	1	<0.001
Stupor	98.1%	0.825	<0.001
Loss of initiative	88.5%	0.797	<0.001
Vegetative abnormalities	98.1%	0.658	<0.001

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Table 4. Score correlations between scales/subscales.

Rater		A	A	A	A	B	B	B	B	A	B	A	B
	Subscale	NCRS MA	NCRS AA	NCRS BA	NCRS TOT	NCRS MA	NCRS AA	NCRS BA	NCRS TOT	BFCRS TOT	BFCRS TOT	DSM TOT	DSM TOT
A	NCRS MA	—											
A	NCRS AA	0.397	—										
A	NCRS BA	0.423	0.609	—									
A	NCRS TOT	0.556	0.838	0.777	—								
B	NCRS MA	0.981	0.395	0.428	0.551	—							
B	NCRS AA	0.392	0.868	0.589	0.783	0.386	—						
B	NCRS BA	0.400	0.595	0.900	0.728	0.390	0.563	—					
B	NCRS TOT	0.542	0.799	0.745	0.929	0.535	0.830	0.753	—				
A	BFCRS TOT	0.488	0.662	0.701	0.735	0.476	0.616	0.658	0.699	—			
B	BFCRS TOT	0.502	0.583	0.705	0.700	0.514	0.577	0.655	0.691	0.855	—		
A	DSM TOT	0.579	0.624	0.612	0.649	0.567	0.637	0.567	0.637	0.694	0.630	—	
B	DSM TOT	0.467	0.629	0.600	0.611	0.484	0.637	0.530	0.599	0.640	0.617	0.873	—

Legend: AA= Affective Alterations; BA= Behavioral Alterations; BFCRS= Bush-Francis Catatonia Rating Scale; DSM= Diagnostic and Statistical Manual of Mental Disorders; MA= Motor Alterations; NCRS= Northoff Catatonia Rating Scale; TOT= Total score.

Table 5. Decision statistics of the Northoff Catatonia Rating Scale when the gold standard is DSM-5 criteria.

Table 5A. Confusion matrix.

	DSM-5 Positive	DSM-5 Negative	Total
NCRS Positive	7	5	12
NCRS Negative	0	40	40
Total	7	45	52

Table 5B. Decision statistics.

		95% Confidence Interval	
Statistics	Estimate	Lower limit	Upper limit
Apparent prevalence	23.1 %	12.5 %	36.8 %
True prevalence	13.5 %	5.6 %	25.8 %
Test sensitivity	100.0 %	59.0 %	100.0 %
Test specificity	88.9 %	75.9 %	96.3 %
Diagnostic accuracy[a]	90.4 %	79.0 %	96.8 %
Positive predictive value	58.3 %	27.7 %	84.8 %
Negative predictive value	100.0 %	91.2 %	100.0 %

(*Continue*) **Table 5B**

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(*Continue*) **Table 5B.**

		95% Confidence Interval	
Statistics	**Estimate**	**Lower limit**	**Upper limit**
Proportion of subjects with the outcome ruled out	76.9 %	63.2 %	87.5 %
Proportion of subjects with the outcome ruled in	23.1 %	12.5 %	36.8 %
Proportion of false positives	11.1 %	3.7 %	24.1 %
Proportion of false negative	0.0 %	0.0 %	41.0 %
Youden's index[b]	0.889	0.350	0.963
Likelihood ratio of a positive test	9.000	3.939	20.566
Likelihood ratio of a negative test	0.000	0.000	NaN

Legend: DSM= Diagnostic and Statistical Manual of Mental Disorders; NCRS= Northoff Catatonia Rating Scale.
[a]Proportion of all tests that give a correct result; [b]Youden's index is the difference between the true positive rate and the false positive rate. Youden's index ranges from -1 to +1 with values closer to 1 if both sensitivity and specificity are high (i.e., close to 1).

our sample presented catatonia. When the BFCRS was used as the gold standard tool for the diagnosis, the NCRS had a sensitivity of 71.4% and a specificity of 94.7%. Given the higher prevalence of catatonia according to the BFCRS score (26.9%), the positive predictive value is 83.3% and the negative predictive value 90%, with an overall accuracy of 88.5%. Youden's J Statistic is lower than the one reported above and is 0.662 (table 6A and 6B). The internal coherence of the total score with the motor subscale was higher (Cron-

Table 6. Decision statistics of the Northoff Catatonia Rating Scale when the gold standard is the BFCRS score.

Table 6A. Confusion matrix.

	BFCRS Positive	BFCRS Negative	Total
NCRS Positive	10	2	12
NCRS Negative	4	36	40
Total	14	38	52

Table 6B. Decision statistics.

		95% Confidence Interval	
Statistics	**Estimate**	**Lower limit**	**Upper limit**
Apparent prevalence	23.1%	12.5%	36.8%
True prevalence	26.9%	15.6%	41.0%
Test sensitivity	71.4%	41.9%	91.6%
Test specificity	94.7%	82.3%	99.4%
Diagnostic accuracy[a]	88.5%	76.6%	95.6%
Positive predictive value	83.3%	51.6%	97.9%
Negative predictive value	90.0%	76.3%	97.2%
Proportion of subjects with the outcome ruled out	76.9%	63.2%	87.5%
Proportion of subjects with the outcome ruled in	23.1%	12.5%	36.8%
Proportion of false positives	5.3%	0.6%	17.7%
Proportion of false negative	28.6%	8.4%	58.1%
Youden's index[b]	0.662	0.241	0.910
Likelihood ratio of a positive test	13.571	3.384	54.434
Likelihood ratio of a negative test	0.302	0.131	0.693

Legend: BFCRS= Bush-Francis Catatonia Rating Scale; NCRS= Northoff Catatonia Rating Scale.
[a]Proportion of all tests that give a correct result; [b]Youden's index is the difference between the true positive rate and the false positive rate. Youden's index ranges from -1 to +1 with values closer to 1 if both sensitivity and specificity are high (i.e., close to 1).

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bach's α=0.894) than the coherence with the affective (0.747) or behavioral (0.741) subscales (figure 1).

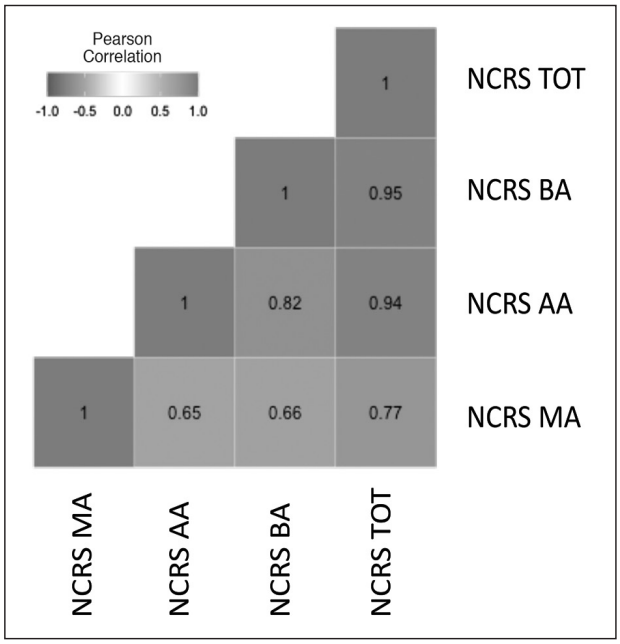

Figure 1. Correlations between the score of the subscales and the total score of the Northoff Catatonia Rating Scale.
Legenda: AA= Affective Alterations (subscale); BA= Behavioral Alterations; MA= Motor Alterations; NCRS= Northoff Catatonia Rating Scale.

Discussion and conclusion

Catatonia is a heterogeneous syndrome that entails motor and behavioral signs and affective symptoms. Due to the high variability of clinical presentations, catatonia has been extensively underdiagnosed, especially in non-psychiatric clinical settings. Most importantly, such a delay in diagnosis and prompt treatment, i.e., the total duration of untreated catatonia, could lead to serious physical consequences[20] and death[21]. In this study, we aimed to provide a rater-friendly tool for diagnosing catatonia by translating and validating the Italian version of the Northoff Catatonia Rating Scale (NCRS) for the diagnosis and clinical assessment of catatonia. This scale was validated in an in-patient sample of 14 patients with catatonia and 38 without, according to the Bush-Francis Catatonia Rating Scale (BFCRS), or seven patients with catatonia and 42 without according to the stricter DSM-5 criteria (table 1). The NCRS showed high accuracy and inter-rater agreement in discerning patients with catatonia from those without (table 2). In particular, we highlight that the inter-rater agreement for the diagnosis was 100%, with higher chances of agreement between the examiners for the assessment of motor alterations (100%) than for affective (92.3%) of behavioral (94%) ones (table 3). Although the NCRS guides the examiner through an in-depth and painstakingly assessment of the signs of catatonia, some affective and behavioral alterations (such as agitation and abnormal speech) are more difficult to objectify, probably due to their volatility. We also determined the correlation among the subscales of the NCRS, which showed high inter-subscale correlations, thus further supporting the evidence of a relationship between psychological and motor symptoms in catatonia in the Italian in-patient population (table 4). Furthermore, we computed the internal coherence of the NCRS and its subscales through Cronbach's α, which ranged from 0.74 to 0.89, thus showing good internal coherence. Lastly, we examined the prevalence of catatonia according to the NCRS, BFCRS and DSM-5 criteria. We showed that the DSM-5 criteria (motor and behavioral) are less prone to diagnose catatonia (estimated prevalence= 13%). On the contrary, the BFCRS is the most sensitive scale among the three for diagnosing catatonia (prevalence= 26%). The NCRS yields prevalence estimates of 23% (table 5-6). However, when comparing the assessment and diagnoses established with the NCRS or other rating scales, the examiner should also keep in mind that there is a lack of consensus on some definitions. For example, according to the NCRS, *mitgehen* is defined as «[the] Patients follow other persons in an inappropriate way either in their gait/walking movements»[2]. In contrast, *mitgehen*, according to the BFCRS, is also termed "passive obedience": «[the] Patient raises [an] arm in response to light pressure of [the] finger, despite instructions to the contrary»[13]. Moreover, posturing and catalepsy are equivalent terms for the BFCRS. In contrast, they are distinct for the NCRS: posturing is the autonomous taking of a posture, whereas catalepsy is the maintenance of a passively-induced (i.e., examiner-induced) posture.

Some limitations to the scale must be acknowledged. Compared to other scales (e.g., Bush-Francis CRS), the NCRS is composed of 40 items, and thus its administration is more time-consuming. A screening tool would mitigate this inconvenience, but it has not been produced yet. Lastly, a thoroughly detailed interviewing procedure for the scale administration has not been reported for the NCRS.

In conclusion, this study provides the translation and validation of the Italian version of the Northoff Catatonia Rating Scale, which can be used as a sensitive tool to diagnose catatonia in hospitalized patients.

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Conflict of interests: Marco Solmi received honoraria/has been a consultant for Angelini/Lundbeck; Giorgio Pigato received honoraria by Angelini/Lundbeck, Otsuka, Janssen, Takeda, Acadia Farmaceutica; Fabio Sambataro received honoraria/has been a consultant for Janssen Cilag SpA. The other authors have no conflict of interests to declare.

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