

Reliability and Validity of the Turkish Translation of the Delirium Rating Scale- Revised-98

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ABSTRACT

Reliability and validity of the Turkish translation of the Delirium Rating Scale-Revised-98

Objective: Delirium is a common neuropsychiatric disorder. The Delirium Rating Scale-Revised-98 (DRS-R-98) is a widely used and well-validated delirium diagnostic and severity scale that has been translated into many languages. We investigated the reliability and validity of the Turkish version of the DRS-R-98.

Method: Data for 30 consecutive delirium patients were obtained from consultation-liaison psychiatry referrals and 30 non-delirium patients were from routine screening following cardiovascular surgery. Two psychiatrist researchers diagnosed all cases using DSM-IV criteria, and independently administered the DRS-R-98 and Mini Mental State Examination (MMSE). Concurrent validity, interrater reliability, inter-battery factor analysis, internal consistency, sensitivity and specificity at various scale cut-off values were analyzed as well as descriptive analyses were performed.

Results: Mean age was 70.2±15.4 and 62.8±12.6, and mean DRS-R-98 total score was 25.7±6.3 and 4.5±2.5 for delirium and non-delirium groups, respectively. Cronbachs' α intraclass coefficients measuring interrater reliability for DRS-R-98 severity and total scale scores were both 0.99 (SVD: 203.74; SVD: 282.98, respectively). DRS-R-98 severity scores were correlated with MMSE ($r=0.87$, $p<0.001$ for both raters). Internal consistency was high for the DRS-R-98 (Cronbachs' $\alpha=0.964$). Cut-off score of 16 for the DRS-R-98 total score had 100% sensitivity and 88.5% specificity, whereas 11 for the DRS-R-98 severity scale had 100% sensitivity and 85.7% specificity.

Conclusion: We believe the DRS-R-98 Turkish version is a valid and reliable tool for clinicians and researchers.

Key words: Delirium, DRS-R-98, DRS-R-98-T, reliability, validity

ÖZET

Deliryum Derecelendirme Ölçeği-Revize-98 Türkçe versiyonunun geçerlik ve güvenilirliği

Amaç: Deliryum yaygın bir nöropsikiyatrik bozukluktur. Deliryum Derecelendirme Ölçeği-Revize-98 (DDÖ-R-98), deliryum tanısı ve şiddetinin belirlenmesi için yaygın olarak kullanılan, birçok dile çevrilmiş, iyi derecede geçerli bir ölçektir. Bu çalışmada Deliryum Derecelendirme Ölçeği-Revize-98 Türkçe versiyonunun geçerlik ve güvenilirliğini araştırdık.

Yöntem: Araştırmaya Konsültasyon liyezon psikiyatri birimine yönlendirilen 30 ardışık deliryum hastası ve kardiyovasküler cerrahi sonrasında rutin olarak takip edilen ve deliryum gelişmeyen 30 hasta alınmıştır. Tüm olguların tanıları iki psikiyatri uzmanı araştırmacı DSM-IV ölçütlerini kullanarak koymuşlar ve birbirlerinden bağımsız olarak DRS-R-98 ve Standardize Mini Mental Test (SMMT) uygulamışlardır. Tanımlayıcı analizlerin yanında, yapı geçerliliği, ölçek içi faktör analizi, değerlendiriciler arası güvenilirlik, DRS-R-98 ölçeğinin SMMT ile uyumu, iç tutarlılık analizleri ile çeşitli kesme değerleri için özgülük ve duyarlılık analizleri yapılmıştır.

Bulgular: Deliryum ve deliryum gelişmeyen gruplar için sırasıyla katılımcıların yaşları 70.2±15.4 ve 62.8±12.6 (Ort.±SS), DRS-R-98 toplam puanları 25.7±6.3 ve 4.5±2.5 olarak bulunmuştur. Değerlendiriciler arası güvenilirlik için Cronbach α değeri hem DRS-R-98 toplam hem de şiddet puanları için 0.99 (SVD: 203.74; SVD: 282.98, sırasıyla) olarak saptanmıştır. DRS-R-98-T Şiddet puanları SMMT ile uyumlu bulunmuştur (her iki değerlendirici için $r=0.87$, $p<0.001$). DRS-R-98 toplam için iç tutarlılık yüksek bulunmuştur (Cronbach $\alpha=0.964$). DRS-R-98 toplam için 16 kesme puanının duyarlılığı %100, özgülüğü %88.5 iken, DRS-R-98 şiddet için 11 kesme puanının duyarlılığı %100, özgülüğü %85.7 olarak bulunmuştur.

Sonuç: DRS-R-98 Türkçe çevirisinin klinisyenler ve araştırmacılar için geçerli ve güvenilir olduğuna, yapılacak deliryum çalışmalarına katkıda bulunacağına inanmaktayız.

Anahtar kelimeler: Deliryum, DRS-R-98, DRS-R-98-T, geçerlik, güvenilirlik



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INTRODUCTION

Delirium is a common and a potentially life-threatening neuropsychiatric disorder. Delirium is a disturbance in consciousness with the cardinal and characterized disturbance of reduced ability to direct, focus, sustain, and shift attention. Inattention is accompanied by other cognitive deficits including of orientation, executive ability, language, visuo-spatial ability, learning and memory, as well as abnormalities of sleep-wake cycle, motor activity, affective control, higher level thought and perception. The onset of delirium may be acute or subacute. These symptoms are usually reversible and their severity fluctuates during the course of the day (1). Delirious patients, in particular the elderly, have worse longer-term outcomes following an episode of delirium (2). Recent research has delineated and validated three core domains for delirium symptoms reflecting cognitive, circadian and higher level thinking symptom clusters (3).

Advanced age is the most important factor for delirium risk, attributed to structural and neurodegenerative changes, reduced neurochemical flexibility, and oxidative stress associated with normal and/or abnormal aging. Preexisting cognitive impairment including dementia, comorbid medical conditions (e.g., cardiovascular, infectious, metabolic, major surgery) also increase the risk of delirium occurrence (4). The incidence and prevalence of delirium depends on the population examined and affects 10-30% of hospitalized patients (2,5), and at even higher rates in intensive care settings.

There are several tools used in research and clinical practice to assess delirium severity. The most widely used, well-validated scales are the Mini Mental State Examination (MMSE) (6), Delirium Rating Scale (DRS) (7), Memorial Delirium Assessment Scale (MDAS) (8) and Delirium Rating Scale–Revised 98 (DRS-R-98) (9). The MMSE is a 30-item bedside clinician-administered cognitive test that includes measurement of orientation, memory, comprehension, visuo-construction, and concentration (6). However, it measures only cognition and is not specific to a particular diagnosis (4). The DRS is a 10-item clinician-rated scale developed by

Trzepacz et al. (7) in 1988 and was the first rating scale specifically designed to assess delirium phenomenology at a time when cognitive-only tools were used. It was intended for use in conjunction with a cognitive scale and therefore has only one overall cognitive disturbance item. Its items are anchored by descriptions of characteristics intended to differentiate delirium from other neuropsychiatric disorders as well as to quantitate delirium severity. It significantly distinguished delirium from dementia and other neuropsychiatric disorders. The MDAS is a 10-item clinician-rated scale to assess delirium severity with each item rated on a Likert scale but without phenomenological descriptions to anchor ratings (8). It is designed to allow for repeated administration within 24-hour period but not for delirium diagnosis.

The DRS-R-98 is a major overhaul of the DRS in structure and content and has become an essential tool in delirium assessment and research. Timmers et al. (10) claimed that DRS-R-98 is the best overall of delirium rating tool largely because of its range of symptoms and suitability for use by physicians and research assistants after training as do Kean and Ryan (11). The DRS-R-98 is available in a number of languages including Spanish, Japanese, Korean, Portuguese, Greek, Danish, Dutch, German, French, Lithuanian, Norwegian, Italian, Turkish, Hebrew, and both traditional and modern Chinese (4,10,11). The DRS-R-98 has been revalidated in several countries (12-18).

The purpose of this study is to evaluate the reliability and validity of the Turkish version of the DRS-R-98.

METHODS

Sample

This study was conducted in inpatient settings of Gulhane Military Faculty of Medicine, Ankara, during the calendar year 2010. Delirium patients were recruited consecutively from the Psychiatry Consultation-Liaison department whose research psychiatrist diagnosed delirium using DSM-IV diagnostic criteria. Patients who constituted the non-delirium group were recruited from the cardiovascular surgery department where patients

are routinely screened and evaluated for delirium symptoms by the research psychiatrists after surgery. Research psychiatrists diagnosed delirium using DSM-IV diagnostic criteria and rated the DRS-R-98 for both groups. Delirium and non-delirium groups each had 30 patients, and included comorbid dementia patients determined by both previous diagnosis and DSM-IV criteria.

Ankara Ethics Committee Number 7 approved this study, and no financial support was taken from any source.

Measures

Mini Mental State Examination (MMSE):

MMSE is a widely used screening test for cognitive impairment, which assesses orientation, attention, visuo-spatial ability, comprehension and memory including short-term recall. It was reported that serial assessment with the MMSE predicts delirium with 93% sensitivity and 90% specificity though it also detects dementia and other etiologies of cognitive impairment (19). The MMSE was validated in a Turkish population (20). The Turkish translation of the MMSE was administered independently from (by the other research psychiatrist prior to the DRS-R-98 rating) but on the same day as the DRS-R-98. Raters were alternated for MMSE and DRS-R-98. Its scores were not used to rate the DRS-R-98-T. MMSE scores were used to assess concurrent validity of DRS-R-98-T. MMSE was administered by one of the research psychiatrist before rating the DRS-R-98, performing psychiatrist was changed for the other patient evaluation.

Delirium Rating Scale Revised-98 (DRS-R-98):

The DRS-R-98 is a 16-item clinician-rated scale usually rated over a 24-hour period for diagnosis. The Severity scale has 13 items to rate delirium severity and can be repeated in a chosen time frame. Items cover a broad range of cognitive and non-cognitive symptoms characteristic of delirium, each anchored by specific phenomenological descriptions for each level (0-3 points). Three diagnostic items that assess temporal course and etiological attribution were designed to

differentially diagnose delirium from other disturbances such that the total scale can be used as a diagnostic instrument. The original DRS-R-98 had high validity, reliability, internal consistency, specificity, sensitivity, and differential diagnostic ability (9). A Cognitive subscale (items 9-13) and Neurobehavioral subscale (items 1-8) have been reported elsewhere (21) but not validated. Core domain items were analyzed in this report as a possible subscale (items 1, 5-13). After permission was granted by the copyright owner (PTT), the DRS-R-98 was translated into Turkish by M.A.C. and back-translated by an independent translator. The final version of the Turkish version of the DRS-R-98 was reviewed and determined by A.O.

Patients were evaluated between 08:00-10:00 AM and ratings of the DRS-R-98 scale items covered the preceding 24 hour period. The raters could choose their own standardized examination methods to rate memory, attention, and visuospatial ability items. Two researchers (M.A.C. and K.N.O.) visited all the patients together and rated the DRS-R-98-T independently to assess interrater reliability. One rater examined the patient while the other listened. After one rater completed his examination and left the ward, the other one performed any additional examination needed to complete his own scoring.

Statistical Analysis

Statistical analyses were performed using a commercially available statistical software packages (StatsDirect Ltd. StatsDirect statistical software. <http://www.statsdirect.com>. England: StatsDirect Ltd. 2008.: MedCalc Version 11.6.1© 1993-2011 MedCalc Software bvba MedCalc Software, Broekstraat 52, 9030 Mariakerke, Belgium). Descriptive features were described as mean±standard deviation (SD) values. Student's t test, chi-Square test, and Fisher's Exact test were used to analyze descriptive data. Data comparisons between the groups were made using Mann-Whitney-U test. The DRS-R-98-T was compared to MMSE and DSM diagnosis. Concurrent validity to the MMSE was assessed using the Pearson correlation test. MMSE and DRS-R-98T scores recorded by researcher #1 were used

for the analyses. To assess interrater reliability for DRS-R-98 total and severity scores, intraclass correlation coefficients were calculated. Singular value decomposition (SVD), explained in detailed elsewhere, values were calculated for inter-battery factor analysis (22). Internal consistency was evaluated using Cronbach's alpha. DRS-R-98-T Total and Severity scales were compared to DSM-IV delirium categorization using receiver operation characteristic (ROC) analyses to produce sensitivity and specificity at various scale cut-off values.

RESULTS

A total of 60 patients were recruited in the study, 30 in each group. The mean age was 70.2 ± 15.38 for delirium and 62.8 ± 12.63 for non-delirium groups with ranges encompassing young adults to the "old old" (Table 1). There were 16.6% (n=5) dementia patients in the delirium group and 10% (n=3) in the non-delirium group. MMSE scores were significantly different between groups ($p < 0.001$, 95% CI=-13 to -9).

Median and minimum-maximum values for DRS-R-98 severity items and scale and subscale scores are listed in Table 2. All DRS-R-98 item, scale and subscale scores were significantly different between groups. The highest mean item scores on the DRS-R-98

in the delirium group were for sleep-wake cycle, lability of affect, thought process and all cognitive items except for short-term memory.

Figure 1 shows boxplot distributions of scores comparing groups (median and quartiles) for DRS-R-98 total and severity scales and MMSE scores. There was a significant difference between the groups for DRS-R-98 total and severity, and MMSE scores (significance is at $p < 0.001$ level for all). Internal consistency was high - Cronbach's alpha coefficient for the DRS-R-98 total was 0.96 and for the DRS-R-98 severity was 0.86 (Table 2). Individual items' alpha coefficients ranged from 0.95-0.96 for the DRS-R-98 total and 0.81-0.86 for the DRS-R-98 severity.

The ICC for interrater reliability was high for both DRS-R-98 total and severity with 0.99 (SVD values were 203.74 and 282.98, respectively). Such reliability was also observed for subscales: 0.99 for the core domain and cognitive subscales (SVD values were 42.77 and 14.53, respectively), and 0.98 for neurobehavioral subscale (SVD value was 32.40).

Concurrent validity of the DRS-R-98 was assessed by comparison with MMSE to the extent that cognitive impairment is one component of delirium. Pearson correlation was high between DRS-R-98 total and severity scores and MMSE scores in the delirium group ($r = -0.86$ $p < 0.001$ for each, $n = 30$).

Table 1: Demographics and MMSE scores in hospitalized patients grouped by their diagnosis

Variable	Delirium n=30 (%)	Non-delirium n=30 (%)	p
Age (mean±SD) (range)	70.20±15.38 (21-90)	62.80±12.63 (30-80)	0.562*
Sex -male	18 (60)	24 (80)	0.091**
Setting			
General medical	5 (16.6)	-	NA
Medical-ICU	5 (16.6)	-	
Surgical	2 (6.6)	-	
Cardiac surgery-ICU	18 (60)	30 (100)	
Primary diagnosis of cases			
Post-op	9 (30)	30 (100)	NA
Metabolic	9 (30)	-	
Trauma	7 (23.3)	-	
Infection	4 (13.3)	-	
Cancer	1 (3.3)	-	
Dementia	5 (16.6)	3 (10)	0.71***
MMSE	16.73±3.98	27.67±3.05	<0.001*

MMSE: Mini Mental State Examination, Data are expressed as n (%) except for age and MMSE scores, which are mean±standard deviation, *Student's t test, **Chi-Square test, ***Fisher's Exact test, NA: Not applicable

ROC analysis for DRS-R-98 scores comparing delirium and non-delirium groups revealed sensitivity and specificity at various cut-off values for DRS-R-98 total and severity scores are shown in Figure 2 and Table 4. The best cut-off score was 16 for the DRS-R-98

total score with 100% sensitivity (95% CI=86.2 to 100) and 88.5% specificity (95% CI=73.2 to 96.7), and 11 points for the DRS-R-98 severity score with 100% sensitivity (95% CI=86.2 to 100) and 85.7% specificity (95% CI=73.2 to 96.7).

Table 2: Median and minimum-maximum values for DRS-98 items and subscales

DRS-R-98 Items	Delirium (n=30)	Non-delirium (n=30)	p*
1. Sleep-wake cycle disturbance	2 (1-3)	1 (0-3)	<0.001
2. Perceptual disturbance and hallucinations	1 (0-3)	0 (0-1)	<0.001
3. Delusions	2 (0-3)	0 (0-2)	<0.001
4. Lability of affect	2 (0-3)	0 (0-2)	<0.001
5. Language	1 (0-3)	0 (0-1)	<0.001
6. Thought process abnormalities	2 (0-3)	0 (0-2)	<0.001
7. Motor agitation	2 (0-3)	0 (0-1)	<0.001
8. Motor retardation	1 (0-3)	0 (0-1)	0.0179
9. Orientation	2 (0-3)	0 (0-1)	<0.001
10. Attention	2.5 (1-3)	1 (0-2)	<0.001
11. Short-term memory	1 (0-2)	0 (0-1)	<0.001
12. Long-term memory	2 (1-3)	0 (0-2)	<0.001
13. Visu-ospatal ability	2 (1-3)	0 (0-1)	<0.001
14. Temporal onset of symptoms	2 (0-3)	0 (0-1)	<0.001
15. Fluctuation of symptom severity	1 (1-2)	0 (0-0)	<0.001
16. Physical disorder	2 (1-2)	1 (1-1)	<0.001
DRS-R-98 Subscales			
Severity Score	20.5 (13-31)	3 (0-11)	<0.001
Total Score	25 (16-37)	4 (1-12)	<0.001
Cognitive	8.50 (4-13)	1 (0-4)	<0.001
Neurobehavioral	12.5 (5-20)	2 (0-10)	<0.001
Core domain	16 (9-24)	3 (0-7)	<0.001

DRS-R-98: Delirium Rating Scale-Revised 98, All values are significantly different between groups at significance of p<0.001 level except motor retardation which was p=0.0179, *Mann Whitney U test

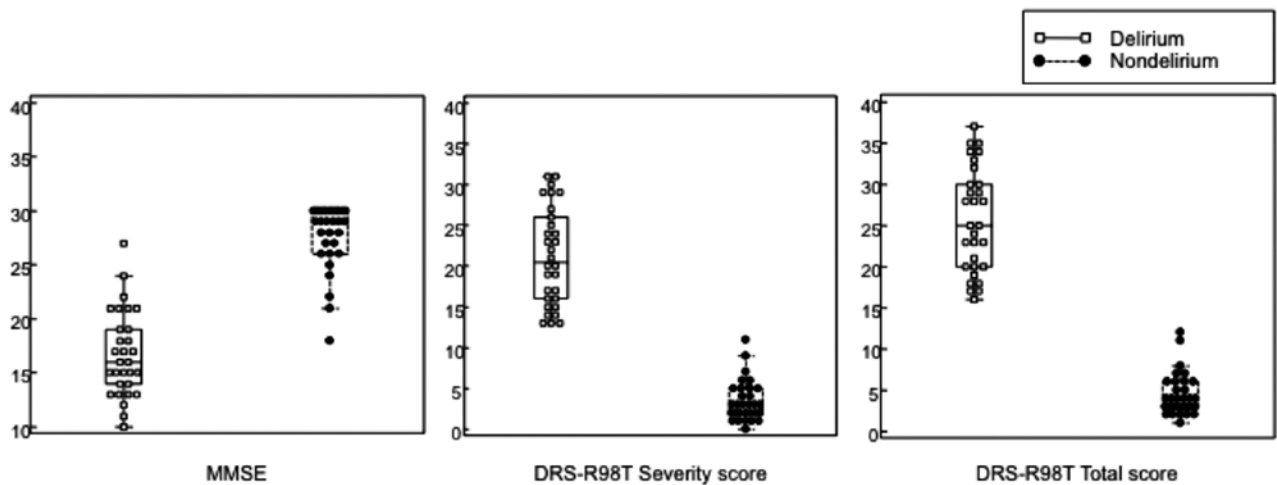


Figure 1: Boxplot distributions for MMSE, DRS-R-98 severity and DRS-R-98 total scores of rater 1
 Boxes represent the middle two quartiles and whiskers the outer two quartiles, with horizontal lines denoting median scores. Circles appearing beyond the whiskers are outliers.

Table 3: Internal consistency of the DRS-R-98 total and severity scales in the delirium group (n=30) expressed as Cronbach's alpha coefficient

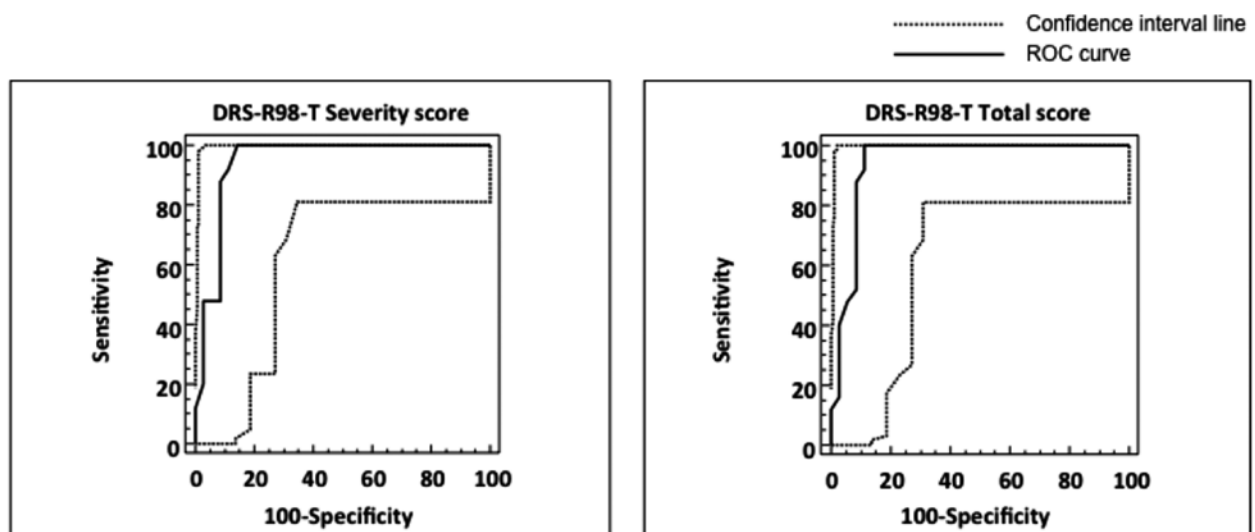
DRS-R-98 item	DRS-R-98 total	DRS-R-98 severity
1. Sleep-wake cycle disturbances	0.96	0.82
2. Perceptual disturbances and hallucinations	0.95	0.82
3. Delusions	0.95	0.82
4. Lability of affect	0.95	0.82
5. Language	0.95	0.84
6. Thought process abnormalities	0.95	0.81
7. Motor agitation	0.96	0.81
8. Motor retardation	0.96	0.86
9. Orientation	0.95	0.83
10. Attention	0.95	0.82
11. Short-term memory	0.96	0.84
12. Long-term memory	0.95	0.82
13. Visuo-spatial ability	0.95	0.83
14. Temporal onset of symptoms	0.95	N/A
15. Fluctuation of symptom severity	0.95	N/A
16. Physical disorder	0.96	N/A
Severity score	0.95	0.84
Total score	0.95	N/A

DRS-R-98: Delirium Rating Scale-Revised 98

Table 4: Values for sensitivity, specificity and positive likelihood ratio (LR) obtained from ROC analysis shown for different cutoff values for the DRS-R-98 total and severity scores

DRS-R-98 total	Cutoff Value	Sensitivity	Specificity	+LR
	>12	100%	85.71%	7.00
	>16	100%	88.57%	8.75
	>20	72%	91.43%	8.40
	>23	56%	91.43%	6.63
DRS-R-98 severity				
	>9	100%	82.86%	5.83
	>11	100%	85.71%	7.00
	>13	92%	88.57%	8.05
	>16	72%	91.43%	8.40

DRS-R-98: Delirium Rating Scale-Revised 98

**Figure 2: ROC analyses and confidence intervals for DRS-R-98 total and severity scores**

DISCUSSION

Recognizing that delirium deserves much more attention in clinical practice, use of highly validated psychometric assessment tools will help detect and monitor delirium better. The DRS-R-98 is a highly validated and internationally recognized delirium assessment tool. We conducted a validation and reliability study of its Turkish version, which adds to the literature of its revalidations in different countries.

Interrater reliability, internal consistency, and construct validity of the DRS-R-98 total and severity scores were very high. The cut-off score from ROC analyses for the DRS-R-98 is compatible with the original DRS-R-98 score, which at 17.75 had 92% sensitivity and 95% specificity. Specificity and sensitivity values are also comparable with other translations of DRS-R-98. Cut-off scores have varied a little across various translations when revalidated in different countries (12-18), though they represent a tight range of scores taken together, and may be reflect the specific cohort evaluated in those studies. We acknowledge that selecting a cut-off score of 11 for the DRS-R-98 severity score improves sensitivity but realize that using 13 as a cut-off score may provide better balance between sensitivity and specificity and where the LR is the highest.

We also report subscale analyses for cognitive and neurobehavioral items and a subscale reflected by items on DRS-R-98 analyses that represent core domain items (4,23-25).

This information about the psychometrics of the Turkish DRS-R-98 will enable choice of tool selection for Turkish speaking populations. There is already a validated Turkish delirium severity assessment scale, the Delirium Rating Scale, developed by Aydemir et al. (26,27). This scale consists 10 items focusing on

symptom severity. Consolidation of different psychomotor activities in one item limits its usefulness in differentiating motor subtypes of delirium, as in the DRS developed by Trzepacz et al. (7,26). Specificity and sensitivity values are higher than the scale developed by Aydemir et al. (26). We did not include any patient controls in the study that may contribute positively on specificity and sensitivity values. But, effect of this limitation on specificity and sensitivity values are not significant when compared other translations of DRS-R-98.

Limitations of this study include use of only the MMSE for construct validity without another delirium rating scale, though its correlation value was higher than in other DRS-R-98 validation reports. Also, allowing comorbid dementia patients was a limitation, though the number was small and about the same between groups, and may reflect cases in routine clinical care. While we did not evaluate longitudinal ratings, the ability of the DRS-R-98 to be sensitive to change has been shown by others (28,29). Small number of the patients included in the study may be considered as another limitation of the study. However, finding delirium cases is not easy to find and the time limit of the study prevent us to include more patients in the study.

While adequate training and clinical experience are key factors for producing reliable symptom ratings in delirium, we have discovered that nurses and clinical psychologists can easily administer the DRS-R-98 after a brief educational and clinical training experience. The DRS-R-98 Administration Guide is a resource that can assist in training for symptom assessment (obtained from PTT@lilly.com). In summary, we demonstrated that the Turkish version of DRS-R-98 is a highly reliable and valid instrument to measure delirium severity and diagnose delirium in Turkish medical settings.

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