



Clinical Study

Validation of the rapid eye movement sleep behavior disorder screening questionnaire in China

Yan Wang^a, Zong-Wen Wang^b, Yue-Chang Yang^a, Hui-Juan Wu^b, Hong-Yi Zhao^a, Zhong-Xin Zhao^{a,*}^a Department of Neurology, Changzheng Hospital, Second Military Medical University, 415 Fengyang Road, Shanghai 200003, China^b Sleep Center, Changzheng Hospital, Second Military Medical University, Shanghai, China

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ABSTRACT

We validated the Chinese version of the rapid eye movement sleep behavior disorder (RBD) screening questionnaire (RBDSQ) and calculated its cut-off value for idiopathic or symptomatic sleep behavior disorders (iRBD or sRBD) in Chinese people. Patients with RBD ($n = 63$) and controls ($n = 165$) were enrolled. After all subjects had completed a structured interview, the Chinese version of the RBDSQ and the video polysomnography test, we evaluated the reliability, areas under the curves and the best cut-off values of the RBDSQ and investigated the utility of RBDSQ for iRBD and sRBD in China. We found that Cronbach's alpha was 0.769 and the test-retest reliability was 0.916. RBDSQ scores in iRBD and sRBD patients were similar and higher than those in controls. A total of five points represented the best cut-off value for detecting all RBD patients. In Parkinson's disease, a total score of six points represented the best cut-off value for detecting sRBD. There was no statistically significant difference in total RBDSQ score between iRBD and sRBD, or male and female patients. There was no significant correlation between the RBDSQ score and duration or severity of RBD symptoms. The Chinese version of the RBDSQ had high sensitivity, specificity and reliability and could be used as a tool for screening RBD patients in China.

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1. Introduction

Rapid eye movement (REM) sleep behavior disorder (RBD) is characterized by intermittent or sustained loss of normal REM sleep electromyographic (EMG) atonia and appearance of elaborate motor activity associated with dream mentation [1]. RBD is divided into idiopathic (iRBD) and symptomatic sleep behavior disorders (sRBD). Many longitudinal studies have revealed that a proportion of iRBD patients eventually develop neurodegenerative diseases [2,3]. Thus, iRBD has been increasingly recognized as a precursor for other symptoms of neurodegenerative processes. Moreover, the frequency of RBD is reported to be up to 60% and some studies have shown a significant association between RBD and nighttime disturbances as well as quality of life in PD patients [4,5]. Given the potential risks that are associated with RBD and the available treatment options, it is recommended that screening for RBD should be performed as early as possible.

The current diagnostic criteria for RBD requires polysomnography (PSG) to demonstrate REM sleep without atonia [6]. However, PSG is costly, labor intensive and impractical to perform. A few

questionnaires that adequately screen RBD have been designed as alternative diagnostics [7] including the Mayo sleep questionnaire, the sleep behavior disorder single-question screen, the Innsbruck sleep behavior disorder inventory, the REM sleep behavior disorder questionnaire-Hong Kong (RBDQ-HK), and the REM sleep behavior disorder screening questionnaire (RBDSQ). RBDSQ is the most commonly used questionnaire at present. It is a 13 item self-rating questionnaire which has been validated in Europe and Japan [8,9]. However, there are some limitations. For example, non-violent dream enactment behavior based on the existence of REM without atonia (RWA; non-violent RBD symptoms) is more common in sRBD patients than iRBD patients [10]. Male RBD patients also had some different clinical manifestations from female RBD patients [10]. But how these differences affect the RBDSQ score is not clear. In this study, we assessed the reliability and validity of the Chinese version of RBDSQ, calculated its cut-off value in Chinese people and explored the effectiveness of the questionnaire in different clinical groups.

2. Methods

Subjects were recruited from the Sleep Center and the Department of Neurology, Chang Zheng Hospital, Second Military

* Corresponding author. Tel.: +86 2181885451.

E-mail address: zhaozx@medmail.com.cn (Z.-X. Zhao).

Medical University from September 2012 to March 2014. Subjects who failed to attain REM sleep on their video-PSG or who were unable to complete the questionnaire were excluded. The diagnosis of sleep disorder was based on the second edition of the International Classification of Sleep Disorders [6]. All subjects signed informed consent forms. The ethics committees of Chang Zheng Hospital, Second Military Medical University approved this study.

We translated the original RBDSQ into Chinese with the permission of the patent owner of the original RSDSQ and modified it to ensure the Chinese version was easy to understand. Afterwards, we invited a professional translator who was not a medical practitioner to translate the Chinese version into English and sent it to Dr. Karin Stiasny-Kolster (the author of the original RBDSQ) to confirm that the translated Chinese version was equivalent to the original version.

Experienced neurologists performed the neurological examinations. Then, the Chinese version of the RBDSQ was given to subjects to be completed. The patients' bed partners input was encouraged but not required [8]. Interviews regarding sleep problems were undertaken and video-PSG tests were performed by a sleep disorder expert physician blind to the RBDSQ results. To validate test-retest reliability, 50 random patients were asked to complete a second set of the questionnaire approximately 2 months after the first assessment. The first and the second set of questionnaires were defined as Time 1 and Time 2, respectively.

Video-PSG recordings were collected and stored digitally using the Polysmith SW-SM2000C polysomnography recorder (Nihon Kohden, Tokyo, Japan) and contained the following montages: bilateral electro-oculogram (EOG) derivations, standard electroencephalographic (EEG) derivations (C3-A2, C4-A1, O1-A2, O2-A1), electrocardiogram chin and two lower limb surface EMG derivations (right and left extensor digitorum communis), oronasal airflow by thermocouple and nasal pressure measurements, sonogram, oxyhemoglobin saturation, and chest and abdomen inductance plethysmography. Sleep stages were scored according to standard criteria [11], but REM sleep was scored on the basis of EEG and EOG only [12]. According to the published method, patients with chin EMG tonic density $\geq 30\%$ or phasic chin EMG density $\geq 15\%$ were considered to meet the PSG criteria of RBD [12,13]. All REM tone quantification carefully eliminated apnea-associated arousals.

Statistical analyses were performed using SPSS statistics (version 19.0; IBM Corporation, Armonk, NY, USA). The Mann-Whitney U-test was used to assess the differences between

groups, the chi-squared test was used to compare the positivity rate and Pearson's correlation analysis was used for ensure correlation between two variables. The internal consistency (estimated by Cronbach's α -coefficient) and test-retest reliability (estimated by intra-class correlation coefficient; ICC) were employed to assess the reliability of the RBDSQ. The sensitivity and specificity for different cut-off points for RBDSQ were calculated and presented by means of a receiver-operator characteristics (ROC) curve. The diagnostic value of the RBDSQ was calculated by the area under the curve (AUC). $p < 0.05$ was considered statistically significant. Both Cronbach's α -coefficient and ICC ≥ 0.7 were considered satisfactory, and AUC ≥ 0.70 was considered adequate [14,15]. Where appropriate, values are presented as the mean \pm standard deviation.

3. Results

In total, 63 RBD patients and 165 controls were recruited. Of these, 39.91% completed the RBDSQ themselves as well as their bed partners. Of the patients, there were 41 with iRBD and 22 with sRBD (all associated with PD). In the control group, there were 78 patients with other sleep disturbances, 37 PD patients without RBD, and 50 healthy subjects in whom RBD was excluded based on medical history rather than the video-PSG test. The Cronbach's α -coefficient for the Chinese version of the RBDSQ was 0.769. The test-retest coefficient (ICC) was 0.916. The Wilcoxon signed rank test did not reveal any significant difference between the scores of the test-retest subjects at Time 1 and Time 2 ($p = 0.309$).

The mean total score for the Chinese version of the RBDSQ in the RBD group was significantly higher than that of the control group (8.05 ± 2.46 versus 2.89 ± 1.79 ; $p < 0.001$; Table 1). The ROC curve revealed that the RBDSQ had good diagnostic accuracy (AUC = 0.947; range: 0.915–0.978; Fig. 1A). The optimal cut-off value was five points for the RBD symptoms (sensitivity of 0.921 and specificity of 0.812). Accordingly, 85.53% of the patients were correctly diagnosed. Single item analysis revealed the highest sensitivity for item 1 and item 6.1 and the highest specificity for items 6.3 and 6.4 of the RBDSQ.

The mean total score for iRBD patients was significantly higher than other sleep disturbance patients or healthy controls (8.07 ± 2.71 , 3.18 ± 1.73 and 2.34 ± 1.95 , respectively; $p < 0.001$; Table 1). The optimal cut-off value for iRBD patients versus other sleep disturbances was five points (sensitivity of 0.902 and

Table 1
Comparison of the mean total score of the Chinese version of the RBDSQ

Groups	n	Age (years), mean \pm SD	Men/women (n)	RBD duration (years), mean \pm SD	RBDSQ total score, mean \pm SD
RBD	63	63.59 \pm 11.35	47/16	9.90 \pm 7.95	8.05 \pm 2.46 [*]
iRBD	41	62.68 \pm 12.41	29/12	8.41 \pm 7.01	8.07 \pm 2.71 ^{*,***}
sRBD	22	65.27 \pm 9.07	18/4	12.73 \pm 9.20	7.95 \pm 1.9 ^{****}
Male RBD	47	62.81 \pm 11.85	47/0	9.60 \pm 8.18	8.36 \pm 2.46
Female RBD	16	65.88 \pm 9.68	0/16	10.81 \pm 7.41	7.06 \pm 2.29
Non-RBD	165	58.50 \pm 14.90	93/72	NA	2.89 \pm 1.79
Other sleep disturbance	78	52.77 \pm 17.10	46/32	NA	3.18 \pm 1.73
PD without RBD	37	65.59 \pm 11.76	20/17	NA	3.03 \pm 1.55
Healthy subjects	50	62.2 \pm 8.85	27/50	NA	2.34 \pm 1.95
PD patients	59	65.47 \pm 10.75	38/21	NA	4.86 \pm 2.95
PD with RBD	22	65.27 \pm 9.07	18/4	12.73 \pm 9.20	7.95 \pm 1.90 ^{****}
PD without RBD	37	65.59 \pm 11.76	20/17	NA	3.03 \pm 1.55

^{*} $p < 0.001$ between the RBD patients and non-RBD subjects.

^{**} $p < 0.001$ between the iRBD patients and other sleep disturbance patients.

^{***} $p < 0.001$ between the iRBD patients and healthy controls.

^{****} $p < 0.001$ between the PD with RBD patients and PD without RBD patients.

iRBD = idiopathic RBD, NA = not applicable, PD = Parkinson's disease, RBD = rapid eye movement sleep behavior disorder, SD = standard deviation, sRBD = symptomatic RBD.

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