International Journal of Gerontology 19 (2025) 23–26
https://doi.org/10.6890/IJGE.202501_19(1).0004

International Journal of Gerontology

journal homepage: http://www.sgecm.org.tw/ijge/

Original Article

Validation of the Taiwan Version of the Rapid Eye Movement Sleep Behavior Disorder Screening Questionnaire

Yi-Ya Fang [a], Yi-Chun Yeh [a,b], Yi-Ting Lin [c], Cheng-Sheng Chen [a,b], Mei-Feng Huang [a,b] *

[a] *Department of Psychiatry, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan,* [b] *Department of Psychiatry, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan,* [c] *Department of Family Medicine, Kaohsiung Medical University Hospital, Kaohsiung Medical University, Kaohsiung, Taiwan*

ARTICLE INFO

Accepted 5 August 2024

Keywords:
REM sleep behavior disorder,
reproducibility of results,
surveys and questionnaires,
Taiwan

SUMMARY

Study Objectives: Rapid eye movement sleep behavior disorder (RBD) in the elderly poses risks of injuries and diminished quality of life, potentially indicating early neurodegenerative disorders. Polysomnography (PSG) is the established diagnostic gold standard but limited use due to cost and accessibility. Some questionnaires such as rapid eye movement sleep behavior disorder screening questionnaire (RBDSQ) emerged as a cost-effective and time-efficient alternative screening tool. To address cultural nuances and unique features among Taiwanese individuals, a Taiwan-specific version of RBDSQ was developed. This study aimed to assess its suitability applied in Taiwan.
Methods: A total of 104 participants aged over 50 underwent PSG. Forty-five participants tested positive for RBD, while 59 tested negative. All completed the Taiwan version of RBDSQ. Internal consistency, evaluated by Cronbach's alpha coefficient, and test-retest reliability, assessed by the intra-class correlation coefficient (ICC), were used to gauge RBDSQ reliability. Areas under the curves (AUCs) were calculated to determine the best cutoff point for RBDSQ.
Results: According to the results, the Cronbach's alpha was 0.734, and ICC was 0.761. At the optimal cutoff point of 5, RBDSQ exhibited a sensitivity of 0.667, specificity of 0.678, and estimated AUC of 0.745 (0.651–0.839). In the elderly subgroup (age ≥ 60), the estimated AUC was 0.802 (0.705–0.899), with a sensitivity of 0.657 and specificity of 0.756.
Conclusions: The Taiwan version of RBDSQ proves valuable as a screening tool, particularly among the elderly. Integrating it into a stepwise diagnostic process, alongside interviews and PSG, facilitates early identification of clinical RBD, offering advantages in clinical practice.

1. Introduction

Rapid eye movement sleep behavior disorder (RBD) is a critically important parasomania, and isolated RBD (iRBD) increases with age, particularly among the elderly.[1] It is characterized by intermittent loss of rapid eye movement (REM) sleep-related muscle hypotonia or atonia. People with RBD would enact the aggressive content of vivid dreams with complex and violent behavior, possibly resulting in severe injury to themselves or their bedpartners.[2] Research has indicated that the presence of RBD might be an early presentation of α-synucleinopathy.[3–6] It may precede a group of degenerative diseases, characterized by the accumulation of alpha-synuclein protein in the brain, including Parkinson disease, multiple system atrophy, and dementia with Lewy bodies.[7] The median conversion time between the emergence of isolated RBD to neurodegenerative disorder was estimated to be around 7.5 years.[8] Thus, timely detection of RBD was emphasized for neuroprotection.

The gold standard tool for RBD diagnosis is polysomnography (PSG).[9] However, non-urgent referral to undergo a sleep study takes around four months, ranging from 0 to 48 months, which depending on the country and healthcare system.[10] PSG not only has a long waiting time, but is also a costly medical expense. Some questionnaires were therefore developed for prompt intervention. The REM sleep behavior disorder screening questionnaire (RBDSQ) is a tool used to screen RBD with a good validity.[11] The high usability of the RBDSQ has led to its translation into various language versions and its application among diverse target populations.[12–16] Though the Chinese version of the RBDSQ had been translated in China,[13] different medical institutions, clinical practices, traditional and simplified Chinese wording, and cultural backgrounds need to be considered. The wording or emphasis of questions may be different. Cultural differences in sleep behavior or symptom expression must also be considered.

Besides, a native study in Taiwan revealed some unique features in Chinese-Taiwan patients different from Caucasian patients, such as lower injury episodes during sleep and more sleep wandering.[17] Under consideration of population diversity and clinical characteristics, invention with the Taiwan version of the RBDSQ is warranted.

In this study, we aimed to explore the reliability and validity of this questionnaire in Taiwan. The target population was individuals without major neuropsychiatric disorders, and we also intended to further examine its application among the elderly.

* Corresponding author. Department of Psychiatry, Kaohsiung Medical University Hospital, Kaohsiung Medical University, No. 100, Tzyou 1st Road, Kaohsiung 807, Taiwan.
E-mail address: lalalabon@gmail.com (M.-F. Huang)

2. Methods

A convenient sampling was adopted. This sample was those who were referred and completed PSG for sleep architecture assessment in the Sleep Center in Kaohsiung Medical University Hospital. Subjects aged 50 or above were enrolled. Those with a clinical diagnosis of major neuropsychiatric disorder, including schizophrenia, major mood disorder, cerebrovascular events, and seizure, were excluded. In total, 104 participants were eventually enrolled. Among them, 45 participants were confirmed as having RBD by the PSG results, and the other 59 were not. RBD was defined according to the criteria in the International Classification of Sleep Disorder, third edition[18] by neurologist clinical evaluation. To meet the criteria, repeated episodes of behavior or vocalization and evidence of REM sleep without atonia on PSG were required.

We translated the original RBDSQ into Mandarin version with the approval of the patent owner of the original RBDSQ to establish the Taiwan version of the RBDSQ. To ensure that the wordings in our translated version of the RBDSQ were both culturally relevant and matched the meanings of the original wordings, the back translation technique was employed, and monolingual testing was conducted. For this study, a bilingual translator translated the English version of the RBDSQ into Mandarin version. Subsequently, the Mandarin version was translated back into English by a psychiatrist. These two translated versions were then compared by two psychiatrists and one neurologist specializing in sleep medicine. The Mandarin content underwent examination and was subsequently approved based on consensus among clinical experts. The Taiwan version was authorized as having feasibility and permitted to be used in this study. The study was approved by the institutional ethics committee of Kaohsiung Medical University Hospital, and informed consent was obtained from each subject. The Taiwan version of the RBDSQ was administered to all 104 participants with the assistance of trained staff. To validate the test-retest reliability, we randomly invited participants in both the RBD-positive and RBD-negative groups to complete the Taiwan version of the RBDSQ again at intervals greater than three months after the first assessment. The Taiwan version of the RBDSQ comprises ten questions and a total of 13 items. The RBDSQ includes specific items that focus on the frequency of dreams, dream content, types of nocturnal movement, injuries to oneself or the bedpartner, dream enactment behavior, sleep disturbance, and neurological disease.[11]

Sample means of the Taiwan version of the RBDSQ total scores in the RBD-positive and RBD-negative groups were compared using the Mann-Whitney U-test. We also used Pearson rank correlation to analyze the correlations between items. As for the reliability of the questionnaire, the internal consistency was determined by Cronbach's alpha coefficient, and test-retest reliability was estimated by the intra-class correlation coefficient (ICC). The validity of the Taiwan version of the RBQSD was assessed as well. The sensitivity, specificity and optimal cutoff point were assessed by receiver operating characteristic (ROC) curve and area under the ROC curve (AUC) analysis. $p < 0.05$ was considered to indicate statistical significance.

Factor analysis with principal component analysis and varimax rotation was used to identify underlying relationships between measured variables. Factor numbers were determined using the criterion of eigenvalues > 1 and the Scree test. The latter is a plot of the variance associated with each factor and shows a distinct break between the steep slope of the large factors and the gradual trailing off shown by the others.

3. Results

In this study, there were 104 valid participants recruited. According to PSG confirmation, 59 had no RBD (31 male and 28 female) and 45 had RBD (35 male and ten female). Table 1 shows the demographic variables of the participants in the RBD-positive and RBD-negative groups, with no significant difference in age between the two groups, but significant differences in gender and educational level.

Further analysis was conducted on individuals aged 60 years or older, with 76 valid samples. According to PSG confirmation, 41 had no RBD (24 male and 17 female) and 35 had RBD (27 male and 8 female). Table 2 shows the demographic variables of the participants in the RBD-positive and RBD-negative groups in the elderly group aged older than 60. There were no significant differences in age and gender between the two groups, but a significant difference in educational level.

The Cronbach's alpha coefficient was 0.734. Randomly selected cases were used for test-retest reliability analysis, with a retest coefficient (ICC) of 0.761 ($p < 0.001$), indicating good reproducibility. The Wilcoxon signed-rank test showed a Z value of -0.926, indicating no significant difference between the test and retest of the Taiwanese version of the RBDSQ ($p = 0.355$). Furthermore, the reliability of the RBDSQ among individuals aged over 60 years was examined. The Cronbach's alpha coefficient was 0.740, indicating acceptable internal consistency. Randomly selected cases from each group were used for test-retest reliability analysis, resulting in a retest coefficient (ICC) of 0.767 ($p < 0.001$), suggesting good reproducibility. The Wilcoxon signed-rank test, with a Z value of -0.234, indicated no significant difference between the test and retest of the Taiwanese version of the RBDSQ ($p = 0.815$).

Regarding validity, ROC curve analysis of the Taiwanese version of the RBDSQ score showed good diagnostic accuracy, with an AUC of 0.745 (range: 0.651–0.839). The optimal cutoff score for detecting RBD symptoms was determined to be 5 points, with a sensitivity of 0.667 and a specificity of 0.678, as shown in Figure 1A.

In the elderly population, ROC curve analysis of the Taiwanese version of the RBDSQ score demonstrated good diagnostic accu-

Table 1
Demographic variables and measured variables related to the presence of RBD or not in the whole sample ($N = 104$).

	No RBD Mean ± *SD*	RBD (+) Mean ± *SD*	χ^2/t	*p*
Male	31	35	7.01*	0.013*
Female	28	10		
Age	64.29 ± 8.54	66.69 ± 8.00	-4.46	0.148
RBDSQ	3.59 ± 2.46	6.20 ± 2.91	-4.95***	0.000***
Education	13.17 ± 3.13	10.80 ± 3.62	3.51**	0.001**

RBD: rapid eye movement sleep behavior disorder, RBDSQ: rapid eye movement sleep behavior disorder screening questionnaire.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 2
Demographic variables and measured variables related to the presence of RBD or not in the sample older than 60 years ($N = 76$).

	No RBD Mean ± *SD*	RBD (+) Mean ± *SD*	χ^2/t	*p*
Male	24	27	2.961	0.095
Female	17	8		
Age	68.73 ± 5.92	69.74 ± 6.17	-.73	0.469
RBDSQ	3.12 ± 2.24	6.26 ± 2.82	-5.30***	0.000***
Education	13.12 ± 3.29	10.37 ± 3.69	3.44**	0.001**

RBD: rapid eye movement sleep behavior disorder, RBDSQ: rapid eye movement sleep behavior disorder screening questionnaire.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

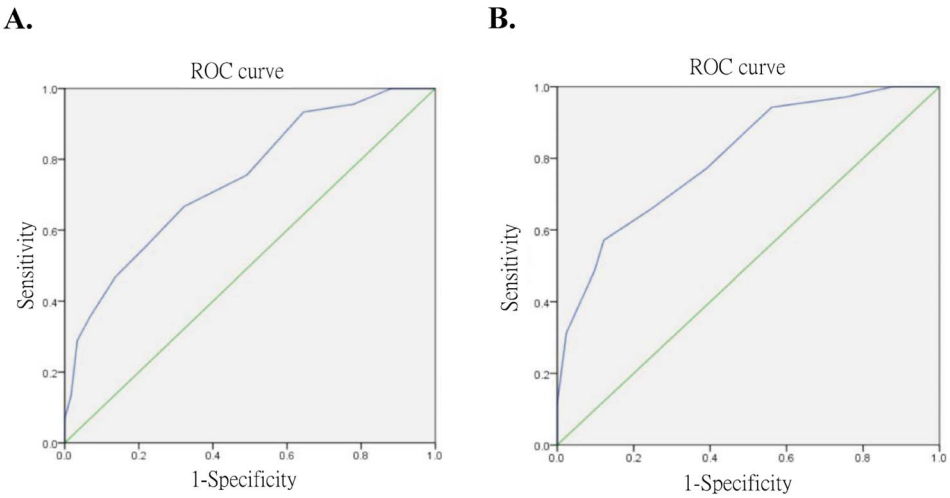

Figure 1. Receiver-operator characteristic (ROC) curves. (A) ROC curves from all subjects. Area under the curve (AUC) = 0.745 (range: 0.651–0.839). The optimal cut-off value for the RBDSQ score for RBD symptoms was 5 points, with a sensitivity of 0.667 and a specificity of 0.678. (B) ROC curves from subjects older than 60 years. AUC = 0.802 (range: 0.705–0.899). The optimal cut-off value for the RBDSQ score for RBD symptoms was 5 points, with a sensitivity of 0.657 and a specificity of 0.756.

racy, with an AUC of 0.802 (range: 0.705–0.899). The optimal cutoff score for detecting RBD symptoms was determined to be 5 points, with a sensitivity of 0.657 and a specificity of 0.756, as shown in Figure 1B.

Factor analysis yielded 3 factors accounting for 51.47% of the total variance. Seven items (2. My dreams frequently have an aggressive or action-packed content. 4. I know that my arms or legs move when I sleep. 5. It thereby happened that I (almost) hurt my bed partner or myself. 6-1. Speaking, shouting, swearing, laughing loudly during my dreams. 6-2. Sudden limb movements, "fights" during my dreams. 6-3. Gestures, complex movements, that are useless during sleep, e.g., to wave, to salute, to frighten mosquitoes, falls off the bed during my dreams. 7. It happens that my movements awake me) made up the factor I accounting for 28.93% of the total variance. Factor II consisted of 2 items (1. I sometimes have very vivid dreams. 8. After awakening I mostly remember the content of my dreams well) accounted for 12.48% of the total variance. Factor III consisted of 3 symptoms (6-4. Things that fell down around the bed, e.g., bedside lamp, book, glasses during my dreams. 9. My sleep is frequently disturbed. 10. I have/had a disease of the nervous system) with 10.06% of explained variance.

4. Discussion

The present validation study showed that the Taiwanese version of the RBDSQ exhibits satisfactory validity and reliability as a screening tool for distinguishing between RBD and non-RBD groups in Taiwan. To assess reliability, we employed Cronbach's alpha and test-retest analysis, which provided insights into internal consistency and reproducibility, even in the elderly.

A total score of five points on the Taiwanese version of the RBDSQ was the optimal cutoff value, demonstrating good sensitivity and specificity for those who were aged above 50 years without major neuropsychiatric disorder. Moreover, the specificity was particularly high, indicating enhanced accuracy when applied to the elderly population.

Compared with the original RBDSQ instrument,[11] which exhibited a sensitivity of 96% and a specificity of 56% at a cutoff level of 5.0 in discriminating RBD patients from healthy controls, the Taiwan version of the RBQSD maintained the same cutoff level but displayed an even higher specificity, while having a lower sensitivity. It is worth noting that the mean RBDSQ score was 6.20 $\pm$ 2.91 points, which was prominently lower among individuals with RBD as compared with the original version's score of 9.5 $\pm$ 2.8 points. This difference could be attributed to variations in recruitment criteria. The Taiwan version excluded individuals with major neuropsychiatric disorders, such as schizophrenia, major mood disorders, cerebrovascular events, and seizures, whereas the original version did not. Item 10 (I have/had a disease of the nervous system) might have had a potential impact on the final results.

Furthermore, a native study conducted by Lin et al.[17] in 2009 explored the characteristics of RBD in Taiwan and identified differences compared with Caucasian populations. Chinese-Taiwanese patients with RBD exhibited a higher proportion of females, fewer instances of injury during sleep, and a higher prevalence of sleep wandering. Notably, item 5 (I (almost) hurt my bed partner or myself) demonstrated the highest specificity in the original version. The differences in presentation characteristics may lead to inconsistent results in the total scale of the RBDSQ.

To acknowledge, this study was the first to discuss the application across different ages, which was a strength of this study. Taiwan's version of the RBDSQ had a better accuracy in the elderly group. Detecting RBD symptoms in the elderly enables early intervention and identification, as RBD is linked to a higher risk of neurodegenerative disorders such as Parkinson disease[19] and dementia.[20] Screening allows healthcare professionals to identify high-risk individuals and implement appropriate management strategies earlier.[21] Screening also helps implement preventive measures for a safe sleep environment and reduces injury risks from dream enacted behavior. Early screening enables timely interventions such as lifestyle modifications and medication management, improving the overall well-being of individuals with RBD.

Furthermore, there is still a lack of native prevalence data on RBD in Taiwan. The prevalence of probable RBD in the elderly Caucasian population (aged 60–97 years), as assessed by the RBD Screening Questionnaire and the Innsbruck RBD Inventory, ranges from 4.6% to 7.7%.[22] Another study in nearby Asian countries reported a prevalence of PSG-confirmed RBD of 2.01% in the elderly Korean population.[23] In Japan, the prevalence of isolated RBD in Japanese elderly individuals was 1.23% [0.66–1.79]%.[24] The Taiwan version of the RBDSQ can be utilized as a screening tool due to its high accuracy, especially in the elderly, which demonstrates even higher ac-

curacy. By understanding the prevalence and impact of RBD in the elderly population, public health authorities can better allocate resources, develop appropriate educational programs, and plan for healthcare services. Screening data can provide valuable insights into the burden of RBD and aid in the development of targeted public health strategies to address the specific needs of this population.

The present study had several limitations. First, the sample size was relatively small due to difficulties in recruitment during the COVID-19 pandemic. Second, there was a lack of a control group consisting of healthy subjects. Third, all participants were recruited from a sleep center and had various pre-existing sleep problems, potentially introducing diagnosis heterogeneity. Administering the questionnaire after the RBD diagnosis could possibly introduce bias into the results. Rate of RBD from this convenient sample won't represent the real prevalence rate among general population. Last, the sex ratio and educational level were not matched between the two groups, possibly affecting the performance of the instrument. Therefore, potential effects of these factors on the instrument's performance cannot be ruled out.

5. Conclusion

In conclusion, the Taiwan version of the RBDSQ demonstrates good sensitivity, specificity, and reliability, making it a valuable screening tool for identifying RBD patients in the Taiwanese population, particularly among the elderly. In clinical practice, the RBDSQ can be incorporated as part of a stepwise diagnostic process, starting with the questionnaire and followed by an interview and PSG. Early identification of clinical RBD is beneficial in both clinical practice and public health policy planning, especially when considering the elderly population in Taiwan.

Acknowledgments

We gratefully acknowledge the financial support from the Ministry of Science and Technology (MOST 109-2314-B-037-079, MOST 111-2314-B-037-039) and Kaohsiung Medical University Hospital (KMUH111-1R67).

Declaration of any potential financial and non-financial conflicts of interest

None.

References

1. Trotti LM. REM sleep behaviour disorder in older individuals: epidemiology, pathophysiology and management. *Drugs Aging.* 2010;27:457–470. doi:10.2165/11536260-000000000-00000
2. Boeve BF. REM sleep behavior disorder: Updated review of the core features, the REM sleep behavior disorder-neurodegenerative disease association, evolving concepts, controversies, and future directions. *Ann N Y Acad Sci.* 2010;1184:15–54. doi:10.1111/j.1749-6632.2009.05115.x
3. Miglis MG, Adler CH, Antelmi E, et al. Biomarkers of conversion to alpha-synucleinopathy in isolated rapid-eye-movement sleep behaviour disorder. *Lancet Neurol.* 2021;20:671–684. doi:10.1016/S1474-4422(21)00176-9
4. Postuma RB, Iranzo A, Hu M, et al. Risk and predictors of dementia and parkinsonism in idiopathic REM sleep behaviour disorder: a multicentre study. *Brain.* 2019;142:744–759. doi:10.1093/brain/awz030
5. Wing YK, Li SX, Mok V, et al. Prospective outcome of rapid eye movement sleep behaviour disorder: psychiatric disorders as a potential early marker of Parkinson's disease. *J Neurol Neurosurg Psychiatry.* 2012;83:470–472. doi:10.1136/jnnp-2011-301232
6. Schenck CH, Boeve BF, Mahowald MW. Delayed emergence of a parkinsonian disorder or dementia in 81% of older men initially diagnosed with idiopathic rapid eye movement sleep behavior disorder: a 16-year update on a previously reported series. *Sleep Med.* 2013;14:744–748. doi:10.1016/j.sleep.2012.10.009
7. Claassen DO, Josephs KA, Ahlskog JE, Silber MH, Tippmann-Peikert M, Boeve BF. REM sleep behavior disorder preceding other aspects of synucleinopathies by up to half a century. *Neurology.* 2010;75:494–499. doi:10.1212/WNL.0b013e3181ec7fac
8. Iranzo A, Fernández-Arcos A, Tolosa E, et al. Neurodegenerative disorder risk in idiopathic REM sleep behavior disorder: study in 174 patients. *PLoS One.* 2014;9:e89741. doi:10.1371/journal.pone.0089741
9. Neikrug AB, Ancoli-Israel S. Diagnostic tools for REM sleep behavior disorder. *Sleep Med Rev.* 2012;16:415–429. doi:10.1016/j.smrv.2011.08.004
10. Flemons WW, Douglas NJ, Kuna ST, Rodenstein DO, Wheatley J. Access to diagnosis and treatment of patients with suspected sleep apnea. *Am J Respir Crit Care Med.* 2004;169:668–672. doi:10.1164/rccm.200308-1124PP
11. Stiasny-Kolster K, Mayer G, Schäfer S, Möller JC, Heinzel-Gutenbrunner M, Oertel WH. The REM sleep behavior disorder screening questionnaire--a new diagnostic instrument. *Mov Disord.* 2007;22:2386–2393. doi:10.1002/mds.21740
12. Miyamoto T, Miyamoto M, Iwanami M, et al. The REM sleep behavior disorder screening questionnaire: validation study of a Japanese version. *Sleep Med.* 2009;10:1151–1154. doi:10.1016/j.sleep.2009.05.007
13. Wang Y, Wang ZW, Yang YC, Wu HJ, Zhao HY, Zhao ZX. Validation of the rapid eye movement sleep behavior disorder screening questionnaire in China. *J Clin Neurosci.* 2015;22:1420–1424. doi:10.1016/j.jocn.2015.03.008
14. Marelli S, Rancoita PM, Giarrusso F, et al. National validation and proposed revision of REM sleep behavior disorder screening questionnaire (RBDSQ). *J Neurol.* 2016;263:2470–2475. doi:10.1007/s00415-016-8285-y
15. Tarı Cömert I, Pelin Z, Arıcak T, Yapan S. Validation of the Turkish version of the rapid eye movement sleep behavior disorder questionnaire. *Behav Neurol.* 2016;2016:8341651. doi:10.1155/2016/8341651
16. Pena-Pereira MA, Sobreira-Neto MA, Sobreira E, et al. Validation of the Brazilian Portuguese version of the rapid eye movement sleep behavior disorder screening questionnaire (RBDSQ-BR). *Arq Neuropsiquiatr.* 2020;78:629–637. doi:10.1590/0004-282X20200125
17. Lin FC, Lai CL, Huang P, Liu CK, Hsu CY. The rapid-eye-movement sleep behavior disorder in Chinese-Taiwanese patients. *Psychiatry Clin Neurosci.* 2009;63:557–562. doi:10.1111/j.1440-1819.2009.01998.x
18. Sateia MJ. International classification of sleep disorders-third edition: highlights and modifications. *Chest.* 2014;146:1387–1394. doi:10.1378/chest.14-0970
19. Postuma RB, Gagnon JF, Bertrand JA, Génier Marchand D, Montplaisir JY. Parkinson risk in idiopathic REM sleep behavior disorder: preparing for neuroprotective trials. *Neurology.* 2015;84:1104–1113. doi:10.1212/WNL.0000000000001364
20. Malkani RG, Wenger NS. REM sleep behavior disorder as a pathway to dementia: If, when, how, what, and why should physicians disclose the diagnosis and risk for dementia. *Curr Sleep Med Rep.* 2021;7:57–64. doi:10.1007/s40675-021-00206-1
21. Bramich S, Verdi K, Salmon K, Noyce A, Alty J. REM sleep behaviour disorder: the importance of early identification in primary care. *Br J Gen Pract.* 2023;73:40–42. doi:10.3399/bjgp23X731721
22. Mahlknecht P, Seppi K, Frauscher B, et al. Probable RBD and association with neurodegenerative disease markers: A population-based study. *Mov Disord.* 2015;30:1417–1421. doi:10.1002/mds.26350
23. Kang SH, Yoon IY, Lee SD, Han JW, Kim TH, Kim KW. REM sleep behavior disorder in the Korean elderly population: prevalence and clinical characteristics. *Sleep.* 2013;36:1147–1152. doi:10.5665/sleep.2874
24. Sasai-Sakuma T, Takeuchi N, Asai Y, Inoue Y, Inoue Y. Prevalence and clinical characteristics of REM sleep behavior disorder in Japanese elderly people. *Sleep.* 2020;43:zsaa024. doi:10.1093/sleep/zsaa024