

Peer Review File

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Reviewer A

First, I want to thank the authors for the efforts they put into this study. The International Classification of Functioning, Disability and Health (ICF) is still little explored in studies involving sleep disorders and the literature is still lacking in information about the functioning of individuals with this health condition.

The authors evaluate Activity and Participation components listed in the Sleep Disorders Brief Core Set considering patients with obstructive sleep apnea (OSA) or not aiming to validate its role in assessing daily activity disorders such as impaired work ability in patients with OSA and provide a better reference for clinical assessment of OSA.

I have major concerns and several issues that would like the authors to consider:

Comment 1: In this study, the authors adopted a numerical scale based on the ICF classifiers being no impairment (0), mild impairment (1), moderate impairment (2), severe impairment (3) and complete impairment (4) and, in this way, values were assigned to each component. Therefore, functioning was not explored in this study, a caveat that deserves to be placed since the ICF is in the WHO family of classifiers for this purpose – to unify the classification of functioning (or disability in its negative perspective). In this way, an adaptation of the use of this tool is perceived. However, the authors do not make it clear in the text that they use the core set in a way adapted to the purpose for which it was developed.

Reply 1: Thanks for bringing up an important point. The performance of the Body Function has been evaluated in previous research of our group (Xie L, Wu Q, Hu W, Li W, Xiang G, Hao S, Guo C, Jiang H, Wu X, Wu X, Li S. Performance of brief ICF-sleep disorders and obesity core set in obstructive sleep apnea patients. *Respir Res.* 2020 Jun 22;21(1):156. doi: 10.1186/s12931-020-01404-1. PMID: 32571309;

PMCID: PMC7310139.). In previous study, the value of the Body Functions component in the Brief ICF-sleep disorders in diagnosing OSA was already identified. The study we conduct now is focus on the working performance of patients with OSA which is an important part of daily and social life influenced by this disease. Therefore, we choose the component of Activity and Participation to be mainly evaluated in this aspect and meanwhile the result of Body Function was also show in Table 3 and Supplementary Table 1 to verify the potential of the Brief Sleep Disorders Core Set.

Methods:

Comment 2: As a strong methodological point, the authors reach a sample composed of 221 participants who underwent polysomnography in a sleep laboratory, in addition to having performed different neuropsychological tests: MoCA, Symbol digit modalities test (SDMT), and Trail making test (TMT).

Reply 2: To evaluate the working ability objectively, MoCA, SDMT and TMT which were extensively used in cognitive neuropsychology were applied here to achieve the solid result.

Comment 3: There is a possibility of bias in the study sample not mentioned by the authors. Individuals with chronic comorbidities associated with OSA were not mentioned since the authors only considered the following aspects as exclusion criteria: - (1) diagnosed with OSA or received OSA treatment previously; (2) patients in acute medical illness; (3) history of psychiatric, or neurological diseases, or psychiatric drug dependence; (4) drug use that affect brain function before the test. Wouldn't chronic conditions impact on impairment in activities and participation in the authors' perception? Another possibility of bias is related to the process of attributing scores to each component of the Core set considered in this study. Was this done blindly? Or is there a possibility of the evaluator assigning the score after knowing the classification of the OAS severity of each participant?

Reply 3: Thank you for these excellent questions. Firstly, the process of information

collection and the final analysis were conducted separately by different researchers according the principle of blinding. Meanwhile, researcher cannot get any information about the group assignment. We have added those illustration in our manuscript in Page7(line173-line179). Secondly, we also take many complications into account. As the result shown in the Table 1 and only hypertension and pharyngitis present significant difference among different group. On the one hand, hypertension is so common in OSA and pharyngitis itself is a typical abnormal state which can both lead to OSA and caused by OSA. It's hardly to isolate them from OSA in clinical research. On the other hand, the patients with hypertension are all well-controlled. And the most important idea we want to share in this work is the value of Activity and Participation in the Brief Sleep Disorders Core Set in accessing the performance of OSA patients during different tasks instead of to identify the main risk factors. That's why we didn't exclude these elements. We add a discussion of this limits as your opinion (Page14, line435-440).

Changes in the text: We have modified our text as advised in the part of Method and Discussion in our manuscript (See page7 line173-179, Page14 line435-440).

Results:

Comment 4: Some results extrapolate the real objectives of the study, for example, data related to other core set components such as function, body structure and environmental factors (line 129 page 5, table 3, and Supplementary Table 1). There is also information related to the Obesity Core Set, which was investigated in other study conducted by the research group, as is clearly specified in the text. This information does not make sense in this manuscript.

Reply 4: We thank the reviewer for mentioning the Obesity Core Set. Actually, the result of Body Structure and Function is an important reference of our study. The Obesity Core Set that shown in the title of Table 3 and Supplementary Table 1 was an error because of our incaution as there is nothing with the Obesity Core Set was included in this study. We apologize for the mistake and we have deleted it in Table 3 and Supplementary Table 1.

Changes in the text: We have amended this mistake in our manuscript of Table 3 and Supplementary Table 1.

Comment 5: The authors found that individuals with OSA had worse scores in the concepts presented in the Activity and Participation component as the severity of OSA increased (according to the AHI classification). These scores were positively correlated with apnea-hypopnea index (AHI), Trail making test (TMT), and negatively correlated with Symbol digit modalities test (SDMT). Based on these findings, the authors performed associations between the TMTb scores and the prediction of impaired attention and work ability in severe OSA with area under the curve, sensitivity and specificity. After these analyses, it was concluded that “Activities and Participation component of the ICF Sleep Disorders Brief Core Set can predict the impairment of attention and work ability in OSA patients”. It would not be daring to explain that the components d160 Focusing attention; d475 Driving; d240 Handling stress and other psychological demands; and d230 Carrying out daily routine to summarize the necessary actions for all work practices? And, in fact, are impairments in these components associated with impaired attention and work ability? To be frank, I believe that the assumption of this association is at least bold.

Reply 5: We appreciate the reviewer for the critical points raised. Firstly, the working ability certainly covers various aspects while SDMT and TMT are traditional and authoritative method used in clinical practice which can reflect the ability of attention and working performance. Secondly, as a preliminary exploration we apply the accepted the Brief Sleep Disorders Core Set. Although the categories included in the Brief Sleep Disorders Core Set which may not cover all work practice but indeed representative. Besides, based on the level of clinical operability, the abundance of data and the compliance of patients need to be balanced, as too many questions and tests can take so much time of patients so that the reliability of data will decrease. Certainly, the predictive ability of ICF Sleep Disorders Brief Core Set should be further improve by adding relevant factors into consideration to meet the command of clinical practice.

Comment 6: As previously stated, functioning or disability (when in a negative perspective) in individuals with OSA is rarely explored in the literature. Authors who carried out these analyses identified that the AHI is not directly related to this impairment (Sharkey KM, Orff HJ, Tosi C, Harrington D, Roye GD, Millman RP. Subjective sleepiness and daytime functioning in bariatric patients with obstructive sleep apnea. *Sleep Breath.* 2013 Mar;17(1):267-74. doi: 10.1007/s11325-012-0685-3. Epub 2012 Apr 13. PMID: 22528950; Timkova V, Nagyova I, Reijneveld SA, Tkacova R, van Dijk JP, Bültmann U. Are disease severity, sleep-related problems, and anxiety associated with work functioning in patients with obstructive sleep apnoea? *Disabil Rehabil.* 2019 Sep;41(18):2164-2174. doi: 10.1080/09638288.2018.1460626. Epub 2018 Apr 17. PMID: 29661090.). This study shows a positive correlation between the severity of OSA and impairments in attention and ability at work, as highlighted in the text above. This deserves a discussion by the authors.

Reply 6: We thank the reviewer for the comments and appreciate mentioning these studies in the field. There are relatively few researches about this topic and the results of them are not all the same. The potential reason may derive from the people included, the sample size, individual variation and so on. Therefore, we have modified our discussion according to the two studies above and other related studies.

Changes in the text: we have modified our discussion according to your suggestion (Page14, line425-440).

Comment 7: The ICF proposal aims to classify functioning considering all the components that are involved in this context: body functions and structure, activities, participation, considering the context (personal and environmental factors) and receiving the influence of the health condition. In the discussion of the data, the authors propose this concept on lines 231–233: “Traditional screening questionnaires and PSGs are mostly aimed at patients with airway obstruction and nocturnal respiratory dysfunction, while insufficient attention has been paid to the overall functional impairment of OSA patients”. Simultaneously, they present a study

limiting the analysis to the activity and participation components that were included in the analysis, scores defined by the authors, do not allow predicting the functioning of individuals with OSA. Quite frankly, from 4 activity components combined with the SDMT and TMTb tests inferring about attention and work ability seems to be bold.

Reply 7: We appreciate the reviewer for reminding us the integrity of the ICF core set. As we mentioned in Reply 1, we have evaluated the value of Body Functions in our previous work so that this part of study is focus on the Activity and Participation and we also evaluated other categories in the rest component to confirm a good reproducibility in the assessment of OSA.

Comment 8: The discussion needs to be rewritten according to the above-mentioned changes.

Reply 8: We have modified our discussion according to your valuable opinions (See page 10-14).

Reviewer B

You have made a huge work to apply ICF brief core set for sleep disorders in your research. However, I have some remarks to improve readability, presentation of the results and possibility to reproduce the study by other groups. The results also need to bring more light into the treatment and rehabilitation of these patients for what ICF was created. Please, present ICF categories as they are in the ICF core set, not by pooling or manipulating in another way.

Comment 1: Please describe how ICF was evaluated: by team, by an investigator, by asking questions, by asking questions and including the results of clinical investigation, by participant himself?

Reply 1: We thank the reviewer for bringing up an important point. Information was collected by questionnaire designed based on the ICF category. Different well-training investigators were participated in the data collection and analysis. Additionally, the

information was collected before the PSG and Neuropsychological Tests to avoid the subjective judgement and follow the principle of doubt-blind.

Changes in the text: We have modified our text as advised to illustrate the method more clearly (See page 7, line173-179).

Comment 2: Please describe the protocol how impairments were graded and present a protocol since the study should be possible to be reproduced by other groups.

Reply 2: We thank the reviewer for this excellent question. As the Brief Core Set of ICF has gave us a framework as well as outline and the user guide of ICF contains many kinds item which can actually be quantified. Therefore, we adapted this item to evaluated the performance of patients and assign the corresponding score. The following is the questionnaire.

The questionnaire designed according to the framework of the Brief ICF Core Set-Sleep Disorders.

Different degree of impairment (Grade)		No (0)	Mild (1)	Moderate (2)	Severe (3)	Complete (4)
Activity and participation						
Code	Category title					
d160	Focusing attention	The times of subject cannot concentrate in the process of doing questionnaire				
		0 times	1-2 times	3-4times	5-6 times	Beyond 6 times
d240	Driving	The times of subject make mistakes in each driving task during past 6 month				
		Never	Rarely	Sometimes	Often	Very often
d475	Handling stress and other psychological demand	The times of serious delays, waivers, or errors in dealing with difficult tasks and emergencies				
		Never	Rarely	Sometimes	Often	Very often

Comment 3: ICF values should be presented as median with min-max since variables are ordinal. It is difficult to understand what value of 0.11 means when ICF core set allows values 0, 1, 2, 3, 4.

Reply 3: Thank you for putting forward this comment. The statistical method is available as the previous studies has already proved. Although the median statistics

are traditionally considered to be more consistent with the application of statistics, given the distribution of the data, the use of mean \pm SD might distinguish and reflect the trend of change in different groups intuitively.

Comment 4: I suggest not to pool Functions (Table 3), Body Structures (Table 3) and Activities and participation (Table 4-6, Figure 1) in respective variables. Every ICF category is unique and important for rehabilitation medicine.

Reply 4: We thank the reviewer for bringing up this great suggestion. We actually analyzed the category of Activity and Participation respectively in Table 3. Activity and Participation, is a in dependent and integrated component of the ICF Core Set ever since the time it was designed so it's also reasonable to be analyzed as a whole. It must be admitted that your opinion is enlightening for us and it may be practicable in some situations. For example, we could analyze this part separately when we just focus on some specific kinds of performance. As a preliminary exploration, we follow the methods of the previous study.

Comment 5: Legend of Table 3: what has Obesity core set here a place?

Reply 5: We apologize for this mistake caused by incautiousness and have deleted this error in the title of the mentioned Tables.

Changes in the text: We have amended this mistake in our manuscript of Table3 and Supplementary Table 1.

Comment 6: Did you control for BMI, smoking, hypertension and pharyngitis in the study as well as pharmacological treatment which by itself is not presented?

Reply 6: We thank the reviewer for the comment. According to epidemiological results, it's obvious that BMI, smoking and pharyngitis are related to the severity of OSA as all of them are risk factors for the development of OSA. Meanwhile, hypertension is also co-existent with OSA so it's hard to eliminate their influence of patients' performance. As a preliminary exploration, what we mainly focused is the

practicability of the Activity and Participation component in the Brief Sleep Disorders Core Set instead of investigating the risk factor which can lead to worse working performance. We add a discussion of these limits (Page14, line435-440).

Changes in the text: We have modified our text as advised (See Page14 line435-440).

Comment 7: Figure 1 includes “ability to work” (lines 197-199). This parameter is not described in study, neither in Table 1 nor in Methods. It is not included in ICF core set for sleep disorders. Please explain and reconsider my remarks regarding pooling activities and participation in one variable (this is not acceptable as categories are very different). ICF is a main instrument in rehabilitation medicine where team members are working with improving activities and participation. Every activity and participation require certain approaches which explains why pooling of ICF categories is no appropriate in clinical meaning although it is more convenient for statistical analysis.

Reply 7: Thank you for this careful observation. According to the first question, it might have an obscure expression in this sentence as the “ability of work” we write here was means the performance of working and the capacity to deal with kinds of affairs, which is the main topic of this study. Activity and Participation, is an independent and integrated component of the ICF Core Set. As a preliminary study of this component, it is more suitable to evaluate it by using the accepted method of the previous study and we also discussed different categories respectively in Table3.

Comment 8: Reference 15: please cite it in a right way (“WH” should be spelled “WHO”) and make it possible to be open.

Reply 8: We greatly apologize for this mistake and we have amended the error in the mentioned reference.

Changes in the text: We have modified our text as advised (See page17, line520).

Reviewer C

Comment: There are a number of factors that can affect human cognitive functions, and one of them is obstructive sleep apnea (OSA). It is known that the decrease in the quality of cognitive functions in patients with OSA is primarily related to impairments in the "executive function", attention and episodic memory, as well as the dynamic factor of mental activity that determines the quality of a person's life, his social behavior and performance. Despite this, there is currently no consensus in the literature regarding the use of neuropsychological methods to assess the severity of cognitive disorders and the prospects for their use in terms of stratifying the risk of developing disorders of daily activity, such as disability in patients with OSA. It seems that these issues are significant and relevant in terms of prevention of cognitive disorders and rehabilitation of cognitive functions.

The results are clearly and well-written. The authors showed convincingly that the activities and participation component of the International Classification of Functioning, Disability and Health sleep disorders brief core set was evaluated for its performance in predicting impaired work ability in OSA. The results of this study open up a new perspective for studying the reversibility of cognitive impairment and applied issues assessing the possibilities of measures that can be taken to prevent cognitive disorders. I think that this is a very worthy work. I express my gratitude to the authors for their work and my great pleasure in reading their results.

Reply: We are greatly appreciating your recognition and comment on this study.