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Adaptation and Psychometric Validation of the Functional Outcomes Sleep Questionnaire (FOSQ) in Mexico City Inhabitants

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Original article

SUMMARY

Excessive daytime sleepiness (EDS) is a highly disabling sleep disorder related to alterations in behavioral performance, work injuries and vehicle accidents. A prevalence of EDS (from 16% to 32%) in the general population is estimated. The Functional Outcomes Sleep Questionnaire (FOSQ) is the most widely used instrument for measuring the impact of EDS in a patient´s functional state in different sleep disorders and it has been validated in various countries. Therefore, the objective of this study was to culturally adapt the FOSQ and to obtain the reliability, construct validity and factor congruence coefficients for the FOSQ-Mexico version. In the initial stage the questionnaire was translated using the standard methodological process. Additionally, the FOSQ cultural adaptation was made by means of the Natural Modified Semantic Networks technique in a sample of 78 participants. In a second stage, the adapted questionnaire was applied to 152 participants to test items discrimination, internal consistency, orthogonal rotation principal component factor analysis and to verify the factor congruence. The results indicated that all 30 FOSQ items were grouped into six factors that explain 67.2% of the total variance, an average α coefficient between 0.85 and 0.94 for the factors. Factor congruence coefficients ranged from 0.360 to 0.969 between the original and the FOSQ-Mexico version. This study demonstrated that the FOSQ version for the residents of Mexico City is reliable, valid and conceptually equivalent to the American version.

Key words: Functional Outcomes Sleep Questionnaire, reliability, validity, excessive daytime sleepiness, sleep disorders, functional status.

RESUMEN

La Somnolencia Diurna Excesiva (SDE) es uno de los problemas de sueño más incapacitantes ya que se relaciona con déficits en la ejecución conductual, accidentes laborales y vehiculares. Se estima una prevalencia en la población general de entre 16% y 32%. El Functional Outcomes Sleep Questionnaire (FOSQ) es el cuestionario más utilizado para medir el impacto de la SDE en el estado funcional de pacientes con diferentes trastornos del dormir, el cual se ha validado en distintos países. Por lo tanto, el objetivo de este estudio fue adaptar culturalmente el FOSQ y obtener la confiabilidad, la validez de constructo y los coeficientes de congruencia factorial para la versión FOSQ-México. En una primera fase se tradujo el cuestionario utilizando el procedimiento metodológico estándar. También se hizo la adaptación cultural de los reactivos mediante la técnica de Redes Semánticas Naturales Modificadas en una muestra de 78 participantes. En una segunda fase, el cuestionario adaptado se aplicó a 152 participantes para determinar la discriminación entre reactivos, la consistencia interna, el análisis factorial con rotación ortogonal con un método de componentes principales y comprobar la congruencia factorial. Los resultados indicaron que los 30 reactivos del FOSQ se agruparon en seis factores que explican el 67.2% de la varianza total, con un coeficiente α total de 0.94 y de 0.85 promedio para los factores. Se obtuvieron coeficientes de congruencia factorial de 0.360 a 0.969 entre la versión original y el FOSQ-México. Se demostró que la versión adaptada del FOSQ para habitantes de la Ciudad de México es confiable, válida y equivalente conceptualmente con la versión norteamericana.

Palabras clave: Functional Outcomes Sleep Questionnaire, confiabilidad, validez, somnolencia diurna excesiva, trastornos del dormir, estado funcional.

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INTRODUCTION

One of the most disabling sleep disorders, and thus of a greater impact on the daily functioning, is the Excessive Daytime Sleepiness (EDS), which can be defined as the difficulty to remain awake and alert during most of the day, which produces unexpected lapses of tiredness or sleepiness.[1] EDS is related to: traffic and work accidents risk increase; attention and concentration deficits, direction difficulties, memory alterations, fatigue and state of mind perturbation, among others.[2]

EDS can be the main pathological component of a sleep disorder as in the case of the hypersomnias of central origin contemplated in the current International Classification of Sleep Disorders.[3] It can also be secondary to sleep insufficiency or fragmentation, as in the case of Sleep-Disordered Breathing (SDB), in which patients frequently complain because of EDS.

Generally, the following have been described as main factors related to EDS: a) qualitative or quantitative sleep deficiencies due to fragmented or insufficient sleep, b) abnormalities in the Central Nervous System, c) alteration of the circadian rhythm due to the desynchronization of the pacemaker because of environment changes (f. ex. rotating shifts), d) associated to SDB, e) metabolic alterations, f) hormonal alterations, g) psychiatric alterations and h) consumption of substances of abuse.[4]

Discrepancies are shown on studies about EDS epidemiology regarding its prevalence. These differences are usually explained by variants in the methodological aspect like the kind of population studied, or by the way the EDS is measured, whether it through scales or interviews. For example, in a systematic review of randomized trials, Ohayon4 reported that 16% of the general American populations ≥18 years of age claims to have propensity for sleeping during the day. Additionally, 32% of the general population ≥65 years of age who present EDS require taking a nap. Bixler et al.[5] used Epworth Sleepiness Scale (ESS) as a subjective report and announced a prevalence of 8.7% in non-obese patients with SDB (Apnea-hypopnea index >15) and an average of 46 years of age, they noticed and increase (13%) in subjects >56 years of age as well.

As of today there are various scales for measuring EDS such as Hoddes Questionnaire[6] and Sleep-Wake Activity Inventory,[7] among others, but the most widely used is ESS which assesses the probability of falling asleep during daytime activities.[8] In general, with these scales, only "how much" does the patient sleep is assessed, but not "how much trouble" it takes them to sleep in situations that require active vigilance.[1] For example, with ESS one may know whether the subject is somnolent or not, but it does not evaluate the affectation provoked by EDS in daytime functionality and life quality (LQ) in general.

Through the questionnaires that evaluate LQ or functional state we can come close to the study of the consequences in daily activities of EDS.

The most disseminated LQ questionnaire is SF-36 (Medical Outcomes Study, 36- Item Short Form)[2] which is used in multiple pathologies including patients with somnolence secondary to SBD. In some studies it has been found that subjectively measured EDS explains only 12% of the SF-36 variance. Studies in other pathologies with hypersomnic components are scarce; consequently there are no specific and enough data about the impact of EDS in LQ.[9-12]

The Functional Outcomes Sleep Questionnaire [FOSQ] was specifically designed for measuring the impact that primary or secondary excessive sleepiness disorders have over daily functionality. The instrument is based upon the concept of functional state, that is, the behavioral daily performance in the physical, psychological and social area.

FOSQ is made out of 30 questions which constitute five domains: a) Activity level, b) Vigilance, c) Intimacy and sexual relationships, d) General productivity and e) Social outcome. It has four answer options: 0 (I don't do this activity for other reasons), 1 (yes, extreme difficulty) 2 (yes, moderate difficulty), 3 (yes, a little difficulty) and 4 (no).

In the first study where the FOSQ validation[1] was published it was showed that it is a valid and trustworthy device, with Cronbach's coefficients (α=0.86-0.91) for the whole questionnaire and each one of the domains and an adequate test-retest reliability (r=0.81-0.90). The construct validity was determined through factor analysis (with orthogonal rotation, the five factors explained 57.3% of the variance) and concurrent validity *vs*. the SF-36 (average *r* 0.22).[1]

The FOSQ is widespread in the sleep medicine field and its psychometric properties have been proved in countries such as Spain, Norway and Turkey.[13-15]

While a Spanish version already exists, it is worth mentioning that there are clear cultural and semantic differences between the different Spanish-speaking countries,[16] therefore it is convenient that the instruments that measure these aspects adapt to the target population and that the factor equivalency is proved. Thus, questionnaires including sleep-related and daytime execution variables which are significant in that population are obtained.[17]

For the aforementioned reasons, even though there is a versions of FOSQ in Spanish, the translation and adaptation of the original version was considered, so as to have a culturally relevant version and because there is no information of the psychometric properties of the instrument in Mexican population yet.

Internal consistency, construct validity and factor congruence coefficients of the adapted questionnaire compared to the original version were obtained.

MATERIALS AND METHODS

Translation of the questionnaire

The methodological procedure suggested by Guillemin[18] was used for the cultural adaptation of health status mea-

surement instruments. A first translation into Spanish was made and subjected to the judgment of specialists who are expert in the area of sleep medicine for its adaptation. Later, an expert in psychometry, unrelated to the area of sleep disorders, made a retranslation of the instrument. Later, the retranslated version was piloted in order to determine the comprehension of questions and how adequate the format for answers was. In this phase, it was detected that participants were confused between answer options 0 (I don't do this activity for other reasons) and 4 (no); for such reason answer 0 was modified [in its Spanish translation syntax] to "this activity, I don't do it for other reasons".

Adaptation of the questionnaire

For the language adaptation of the items and in order to know the cultural relevance of the construct to be measured, the technique of Modified Natural Semantic Networks was employed. It consists on the presentation of stimuli (phrases, words, definitions, among others) to the subjects who are asked to write a minimum of five words that come to their minds while reading it. Later, they are asked to arrange every one of the words assigning number "one" to the word they feel closest to their experience, followed by number "two" and so forth.[19] Phrases associated to cognitions, emotions and behaviors related to sleepiness were used as stimuli. Later on, based on the frequencies, percentages and graphs (Cattell's breaking point), those which are more closely associated from a semantical point of view are then obtained.

This phase was applied on a non-probabilistic sample of 42 women and 36 men who were patients in a National Institute of Health (Tertiary care), with an average of 44 years of age and 12 years of schooling.

The use of this technique allowed us to become familiar with the use of synonyms of SDE, cognitions and behaviors associated to the items. For instance, both the American and Spanish version considered collecting stamps or working in the garden as hobbies, whereas, in the sample studied, the main hobbies were watching TV, listening to music, reading and embroidering. Similarly, regarding cultural differences, the Mexican version used the verb "tomar" instead of "coger" [both meaning "to take"]. For those items related to driving, the American and the Spanish versions used miles and kilometers respectively as a reference for both short and long distances, whereas for this sample, short distance was considered as "driving within the metropolitan area" (1 hr average) and long distance was associated with "long trips" or "driving to a different city in the country". Thanks to these cultural adaptations a final questionnaire was obtained which contained items which are comprehensive of the practices and customs of the people living in Mexico City.

Implementation of the questionnaire

The final questionnaire (Appendix 1) was implemented on 152 participants (74 women and 78 men): 70 were patients of a National Institute of Health (Tertiary care), 42 persons from the general population and 40 undergraduate students (second and fourth terms) from the National University of Mexico (UNAM). The average of the sample was 38.5±16.5 years of age and 10.7±3.5 years of schooling. All participants gave their consent on their participation.

For the first stage of the implementation, 08:00 to 14:00, the patients who were at outpatient care at a National Institute of Health (Tertiary care) were asked to participate and the study was implemented on those giving their consent.

The next stage, implemented from 10:00 to 14:00 hrs., relatives of patients in the waiting rooms of outpatient care (who were not related to those patients participating in the study) were asked to participate. Once they gave their consent, the implementation took place.

On the last stage of implementation, several groups of undergraduate students from the afternoon shift at UNAM were asked to participate and those giving their consent were subject to the implementation.

Analysis of psychometric properties and of factor congruence

The procedure suggested by Nunnally and Bernstein,[20] Reyes-Lagunes, García and Barragán[21] was followed for the psychometric assessment:

1. Item by item frequency analysis, to distinguish whether all answer options were attractive.
2. Discriminant analysis by means of Student's *t* test including extreme quartiles (lowest and highest answers). Those items with a non-significant t ($p>0.05$) were eliminated.
3. Item by item crosstabs to observe direction.
4. Internal consistency analysis. Items with an increased internal consistency coefficient at being suppressed were eliminated.
5. Intercorrelation was made with those items passing the internal consistency criteria to decide the kind of rotation to be made at the factorial analysis.
6. Due to the obtaining of moderate intercorrelation, an orthogonal rotation factor analysis was performed. Cattell's breakpoint was checked to decide the number of real factors. To consider an item as within an item, factor load of 0.40 was taken as a lower limit. Besides, those items loaded with that minimum load in more than one factor were eliminated.
7. Cronbach's alpha coefficient was obtained for the total of items approving factor analysis criteria as well as for each factor.

In order to quantify the congruence between original factors and those obtained in the adapted versions, the formula

Table 1. Sociodemographic and anthropometric characteristics of polled residents from Mexico

Variable	Total sample n= 152	Women n=74	Men n=78	*t*
Years of age	38.50 (16.5)	35.30 (15.40)	41.40 (15.10)	0.59
Schooling years	10.70 (3.5)	10.05 (3.30)	11.20 (3.60)	1.98
Weight, kg	76.20 (20.5)	68.30 (18.80)	83.60 (19.10)	2.41*
Height, m	1.65 (0.1)	1.58 (0.07)	1.70 (0.08)	10.92**
BMI (kg/m^2)	28.01 (2.1)	27.43 (1.40)	28.93 (1.70)	0.49

Data refers to average values and (standard deviation).
Kg= Kilograms, m=meters, BMI: Body Mass Index.
Test *t* corresponds to comparison between men and women.
* p< .01; ** p< .001

proposed by Wrigley and Nauhaus was used for the same set of variables in different samples. With this procedure a factor congruence coefficient was obtained from the correlations between factor loads for each factor. Those factors with a coefficient ≥0.600.[22] can be considered congruent factors.

RESULTS

Table 1 shows the sociodemographic and anthropometric characteristics of all 152 participants.

Psychometric analysis

Item discrimination. *t*=7.77 (p<0.05) in average was obtained among extreme groups (lowest and highest answers). No item was eliminated under this criterion.

First analysis of internal consistency. An average Cronbach's α of 0.94 was obtained for all 30 items (intercorrelations 0.35-0.95). No item was eliminated under this criterion.

Factorial Analysis. Orthogonal rotation (intercorrelations r=0.40 p<0.01) was used. Sufficiency measure of the Kaiser-Meyer-Olkin sample was 0.90. As shown in Table 2, items

Table 2. Rotated component (factor loads) and communalities matrix

Item	Component 1	2	3	4	5	6	Communalities
25. Keeping up the pace of life	**.823**	.123	.203	.296	.125	.148	.816
24. Afternoon activity	**.796**	.103	.209	.384	.109	.275	.839
22. Night activity	**.712**	.111	.206	.442	.125	.277	.773
23. Morning activity	**.630**	.048	.279	.257	.100	.385	.625
1. Concentration	**.603**	.141	.264	.257	.122	.327	.659
10. Main activity or job performance	**.581**	.070	.289	.166	.102	.152	.715
21. Participation in religious acts	**.498**	.083	.315	.320	.059	.001	.471
26. General activity	**.411**	.320	.255	-.052	.256	-.235	.502
30. Modification of orgasm	.063	**.939**	.071	.122	.141	.112	.936
28. Modification of desire	.126	**.938**	.088	.074	.108	.094	.932
27. Modification of sexual activity	.146	**.935**	.077	.108	.145	.058	.942
29. Modification of arousal	.073	**.931**	.107	.137	.165	.088	.937
12. Receiving visitors at home	.211	.097	**.767**	.272	.061	.047	.743
13. Visiting family/friends	.178	.098	**.766**	.224	.035	.094	.722
15. Upsetting interpersonal relations	.395	.054	**.598**	.006	.034	.277	.564
14. Doing things for the family	.441	.071	**.591**	.283	.110	.197	.774
11. Telephone conversations	.094	.036	**.584**	.307	.094	.284	.616
9. Doing paperwork (administrative)	.020	.215	**.563**	.270	.343	.043	.645
5. Household chores	.219	.098	**.522**	-.081	.288	.377	.510
18. Attending conferences	.234	.196	.257	**.756**	.155	.102	.811
19. Attending concerts	.181	.264	.295	**.750**	.166	.084	.797
20. Watching TV	.248	.015	.148	**.685**	.131	.291	.711
17. Watching movies	.327	.057	.209	**.673**	.204	.143	.736
6. Driving short distances	.044	.103	.045	.147	**.839**	.154	.808
7. Driving long distances	.153	.184	.010	.199	**.818**	.151	.831
8. Transit (driving or public transportation)	.171	.183	.174	.081	**.682**	.201	.575
16. Doing exercise	.351	.226	.330	.268	**.430**	-.164	.561
3. Finishing a meal	.141	.050	.139	.125	.239	**.699**	.629
4. Carrying out a hobby	.138	.155	.185	.173	.104	**.690**	.610
2. Memory	.385	.133	.191	.352	.132	**.470**	.587

Table 3. Descriptive statistics, internal consistency coefficients, explained variance percentage and intercorrelations for every factor of the FOSQ (n=152)

Factor (# of items)	Mean ± DE	Cronbach's α	Explained variance	Item - total correlation
Activity level (8)	2.97 ± 1.07	0.90	42.0%	0.31-0.85
Intimacy (4)	2.12 ± 1.63	0.96	11.3%	0.89-0.95
Social outcome (7)	3.28 ± 1.11	0.86	5.7%	0.35-0.79
Vigilance (4)	2.66 ± 1.36	0.89	4.6%	0.56-0.88
Vitality (4)	2.69 ± 1.56	0.80	4.4%	0.38-0.88
Cognition (3)	3.30 ± 1.00	0.66	3.6%	0.42-0.49

were grouped into six factors. In the first one (ranked from a higher to a lower factor load) were grouped those items about the Level of activity: 25, 24, 22, 23, 1, 10, 21 and 26 (42% explained variance); in the second, questions related to phases of Sexual response: 30, 28, 27 and 29 (explained 11.3% of the variance); in the third, items about Social outcome: 12, 13, 15, 14, 11, 9 and 5 (5.7% of the explained variance); in the fourth, questions regarding Vigilance: 18, 19, 20 and 17 (explained 4.6% of the variance); in the fifth, issues about Vitality: 6, 7, 8 and 16 (4.4% explained variance) and lastly, items about Cognition: 3, 4 and 2 (3.6% explained variance).

Total internal and factor consistency post factor analysis. All 30 items that were grouped into the six factors had an α= 0.94 (Table 3). Level of activity factor got a Cronbach's α of 0.90, Intimacy, 0.96; Social outcome, 0.86; Vigilance, 0.89; Vitality, 0.80 and Cognition, 0.66.

Factor congruence analysis

Acceptable congruence coefficients (0.360 to 0.969) were obtained between the original version factors and those obtained for this validation (Table 4).

DISCUSSION

This study avowed for the reliability and validity of the FOSQ version adapted for the residents of Mexico City (FOSQ-Mexico). Using the technique of Modified Natural Semantic Networks allowed us to make an adaptation of the FOSQ that would be culturally relevant to the Mexican population.

Internal consistency coefficients of the questionnaire, comparable with those of the original version, sustain the reliability of this adaptation. Regarding the other published versions, internal consistency coefficients of the FOSQ-Mexico were similar to those of the Norwegian version and slightly higher when compared to the Spanish and the Turkish versions.

One of the contributions of this study when compared to the Spanish, Norwegian and Turkish versions was that its construct validity was obtained by means of factor analysis, thus replicating the psychometric analysis procedure of the original version.[13-15]

Another contribution of the study was that the conceptual equivalence between FOSQ-Mexico and the original version was quantified. Factor congruence coefficients showed adequate and acceptable values between the factors obtained and the original ones, although differences were observed in the factor loads obtained in those items which, hypothetically, were to be grouped into the original factors of General productivity and Socialization.

In this study some of the deficiencies of the Spanish study were also overcome: 1) an insufficient sample for validation (in the bibliography for this area a minimum of five participants per item is recommended) and 2) lack of factor analysis testing the validity of the construct[13,19,21]

Therefore the Mexico-FOSQ instrument is reliable and conceptually equivalent to the version norteamerican version. Establishes the functional state areas that are affected by the SDE in inhabitants of Mexico City.

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Table 4. Factor congruence coefficients between the factors obtained (FOSQ-Mexico) and those of the original version of the FOSQ

FOSQ-Mexico	Activity level	Intimacy & sexual relationships	Social outcome	Vigilance	Vitality	Cognition
FOSQ						
Activity level	**0.941**	0.487	0.830	0.690	0.659	0.625
Vigilance	0.731	0.453	0.651	**0.909**	0.804	0.573
Intimacy & sexual relationships	0.477	**0.969**	0.360	0.353	0.443	0.425
General productivity	0.796	0.449	0.830	0.702	0.675	**0.839**
Social outcome	0.711	0.366	**0.860**	0.547	0.487	0.616

RP = Relaciones de pareja

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APPENDIX 1
Functional Outcomes of Sleep Questionnaire (FOSQ)

(Adapted [to Spanish] by Rodríguez-Pérez V, Valencia-Flores M, Reyes-Lagunes M y Lara-Muñoz, MC)

Note: In this questionnaire the words "sleepy" or "tired" are used to describe a sensation of not being able to keep the eyes open, drowsiness, nodding or feeling the need to take a nap. These words do not refer to the sensation of tiredness or fatigue you might feel after doing exercise.

The questions in FOSQ are answered using numbers 0 to 4:
0 = I don't do this activity for other reasons; 1= Yes, extreme difficulty; 2= Yes, moderate difficulty; 3= Yes, a little difficulty; 4= No.

		0	1	2	3	4
1.	Do you have difficulty concentrating on the things you do because you are sleepy or tired?					
2.	Do you generally have difficulty remembering things, because you are sleepy or tired?					
3.	Do you have difficulty finishing a meal because you become sleepy or tired?					
4.	Do you have difficulty working on a hobby (for example, watching TV, listening to music, reading, knitting, embroidering) because you are sleepy or tired?					
5.	Do you have difficulty doing work around the house (for example, cleaning house, doing laundry, taking out the trash, repair work) because you are sleepy or tired?					
6.	Do you have difficulty operating a motor vehicle for short distances (less than 1 hr.) because you become sleepy or tired?					
7.	Do you have difficulty operating a motor vehicle for long trips because you become sleepy or tired?					
8.	Do you have difficulty getting things done because you are too sleepy or tired to drive or take public transportation?					
9.	Do you have difficulty taking care of financial affairs and doing paperwork (for example, paying your electricity					
10.	Do you have difficulty performing your job or other activities you commit to because you are sleepy or tired?					
11.	Do you have difficulty maintaining a telephone conversation, because you become sleepy or tired?					
12.	Do you have difficulty receiving visitors in your home because you become sleepy or tired?					
13.	Do you have difficulty visiting your family or friends in their home because you become sleepy or tired?					
14.	Do you have difficulty doing things for your family or friends because you are too sleepy or tired?					
15.	**For question 15 answer using only 1, 2, 3 or 4.** Has your relationship with family, friends or work colleagues been affected because you are sleepy or tired?	■				
16.	Do you have difficulty exercising or participating in a sporting activity because you are too sleepy or tired?					
17.	Do you have difficulty watching a movie or video because you become sleepy or tired?					
18.	Do you have difficulty enjoying the theater or a lecture because you become sleepy or tired?					
19.	Do you have difficulty enjoying a concert because you become sleepy or tired?					
20.	Do you have difficulty watching TV because you are sleepy or tired?					
21.	Do you have difficulty participating in religious services, or meetings because you are sleepy or tired?					
22.	Do you have difficulty being as active as you want to be in the evening because you are sleepy or tired?					
23.	Do you have difficulty being as active as you want to be in the morning because you are sleepy or tired?					
24.	Do you have difficulty being as active as you want to be in the afternoon because you are sleepy or tired?					
25.	Do you have difficulty keeping pace with others your own age because you are sleepy or tired?					
26.	**For question 26, just answer using the scale: 1 = very low; 2= low; 3= medium; 4= high** How would you rate your general level of activity?	■				
27.	Has your intimate or sexual relationship been affected because you are sleepy or tired?					
28.	Has your desire for intimacy or sex been affected because you are sleepy or tired?					
29.	Has your ability to become sexually aroused been affected because you are sleepy or tired?					
30.	Has your ability to have an orgasm been affected because you are sleepy or tired?					

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