



## RESEARCH ARTICLE

## Validity and Reliability of Greek Version of Functional Outcomes of Sleep Questionnaire (FOSQ), Comparison of FOSQ with Questionnaires Measuring Sleepiness, Anxiety and Health Status

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### Abstract

**Background:** We developed the Greek version of the Functional Outcomes of Sleep Questionnaire (G-FOSQ) and investigated its reliability and validity in Obstructive Sleep Apnea Syndrome (OSAS) patients.

**Methods:** This is a prospective study, included all 311 consecutive adults, who visited sleep laboratory of a tertiary hospital for evaluation of suspected OSAS in a year period. Participants underwent standard polysomnography study and completed a battery of questionnaires including the Epworth Sleepiness Scale (ESS), Short Form-36 Health Survey (SF-36), and ZUNG Self-Rating Depression Scale (SDS).

**Results:** A total 297 participants (72.4% men, mean age  $52.9 \pm 13$  years, and body mass index (BMI) =  $33.6 \pm 7.2$  kg/m<sup>2</sup>) who had OSAS were included. We assessed the internal consistency, factor analysis, multi-traits scaling analysis, and the concurrent validity of the G-FOSQ. Factor Cronbach's alpha coefficient for all domains of FOSQ exceeded the 0.70 standard for internal consistency. Item domain correlations ranged from 0.37 to 0.90. The global G-FOSQ and the G-FOSQ subscales had medium-sized correlations ( $r = 0.30-0.5$ ) with SF-36 subscales scores. We found excessive decreasing scores of G-FOSQ in patients with ESS > 11. When patients classified based on SDS, no differences were found on G-FOSQ, but there was a positive correlation with the Vigilance subscale and SDS, fact that until now has been shown in patients with Restless Legs Syndrome.

**Conclusions:** The stability of structures and the liability of the questions of the G-FOSQ (0.913) was found to be similar the score of original FOSQ (0.94). The G-FOSQ is a reliable and valid instrument for assessing functional outcome in participants with daytime sleepiness in Greek population with OSA.

### Keywords

Functional outcomes of Sleep Questionnaire (FOSQ), Sleep disorders, Daily activity, Sleepiness, Questionnaires

### Introduction

Obstructive sleep apnea syndrome (OSAS) is one of the most disabling sleep disorders [1] and of a great impact on the daily functioning [2,3]. The Functional Outcomes of Sleep Questionnaire (FOSQ) is widely used measure of functional status resulting from sleepiness and has been effectively employed as a measure of sleep-related quality of life [4] and to assess the impact of known or suspected sleep disturbances on daytime function [5].

The purposes of this study were 1) To examine the factor structure of the Greek translated version (G-FOSQ) and 2) To examine its reliability and validity.

### Methods

This is a prospective study, included all 311 adults,

who visited sleep laboratory of a tertiary hospital for evaluation of suspected OSAS from January 2015 to December 2015.

The night before the Patients Underwent Standard Polysomnography (PSG), they completed a battery of questionnaires included FOSQ, Self Functioning Health Survey-36 (SF-36), Epworth Sleepiness Scale (ESS), and The Zung Self-Rating Depression Scale (SDS) in a private place, without any guidance. Explanations were given only as general guidelines by a nurse.

Demographic and medical history was recorded reviewing the medical records from the hospital data. The ethical committee approves the study as it was a non-interventional study.

OSAS was diagnosed and evaluated using the standard PSG. Apneas, hypopnea, Apnea/hypopnea Index (AHI), were defined as indicated (AASM) [6].

### Functional outcomes of sleep questionnaire

The FOSQ was specifically designed for measuring the impact that primary or secondary excessive sleepiness disorders have over daily functionality. It is a self-administered questionnaire [7] made out of 30 questions which constitute five subscales: 1) Activity level (9 items); 2) Vigilance (7 items); 3) Intimacy/sexual relationships (4 items); 4) General productivity (8 items) and social outcomes (2 items). Has a 4-point Likert response format (1 = extreme difficulty, 2 = moderate, 3 = little, 4 = no difficulty). Missing responses are not included in the score calculation. Subscale scores range from 1-4 with total scores ranging from 5-20, with higher scores indicating better functional status.

### Self functioning health survey-36

The SF-36 Health Survey [8] is a 36 item self-administered questionnaire which assesses non-disease specific health-related quality of life, validated in Greek [9] and covering the domains: Mental health functioning (social functioning, role-emotional, vitality, mental health) and physical functioning (role-physical, bodily pain, general health, physical functioning).

### Epworth sleepiness scale

The ESS [10] is a short-self-administered questionnaire that provides information on daily conditions of sleepiness [11]. Scores > 11 are generally considered positive for Excessive Daytime Sleepiness (EDS).

### The zung self-rating depression scale (SDS)

The SDS [12] is a 20-item self-report assessment device built to measure anxiety levels, scoring: Cognitive, autonomic, motor, and central nervous system symptoms [13].

### Statistical Analysis

Basal characteristics were described as mean  $\pm$  standard deviation for quantitative variables. The Pearson correlation coefficient and level of significance were used to compare the questionnaires. Probability values of  $p < 0.05$  were considered as statistically significant.

Internal consistency reliability was assessed using Cronbach's alpha [14] and test-retest reliability with an interclass correlation coefficient. Construct validity for the FOSQ subscales were assessed by comparing with the SF-36 scales. The software SPSS 21.0.0 (Chicago IL, USA) was used.

### Results

During a year period of study, a PSG study was conducted in 311 individuals. We excluded 14 subjects: 3 who did not wish to complete the questionnaire, 9 who received psychiatric treatment, and 2 who had undergone a year's follow-up study. Eventually 297 people joined and evaluated: 215 (72.4%) men and 82 (27.6%) women. The mean age of the participants was 52.9  $\pm$  13years (range 18-85 years) and the mean Body Mass Index (BMI) was 33.6  $\pm$  7.2 kg/m<sup>2</sup> (range 20.5-62.5 kg/m<sup>2</sup>).

### Structural construct validity

When assessed the test-retest reliability with an interclass coefficient to correlate the 5 sub-sections of the questionnaire with the questions that they consist, we found significant correlation (Table 1).

**Table 1:** The structural construct validity of all 30 questions (Q) of the FOSQ questionnaire was assessed by the test-retest reliability with an interclass coefficient for each of 5 sub-scales of the FOSQ.

		Activity	Vigilance	General productivity	SOC OUTC	Intimacy sex act
Q1	r =	<b>0.51</b>	<b>0.52</b>	<b>0.61</b>	0.39	0.39
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.00	0.00
Q2	r =	0.31	0.21	<b>0.41</b>	0.24	0.24
	p =	0.00	0.00	<b>0.00</b>	0.00	0.00
Q3	r =	0.26	0.25	<b>0.65</b>	0.17	0.05
	p =	0.00	0.00	<b>0.00</b>	0.01	0.42
Q4	r =	<b>0.59</b>	<b>0.33</b>	<b>0.43</b>	0.32	0.23
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.00	0.00

Q5	r =	<b>0.50</b>	<b>0.70</b>	<b>0.47</b>	0.35	<b>0.49</b>
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.00	<b>0.00</b>
Q6	r =	<b>0.52</b>	<b>0.69</b>	<b>0.47</b>	0.34	<b>0.44</b>
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.00	<b>0.00</b>
Q7	r =	0.32	0.28	<b>0.61</b>	0.17	<b>0.48</b>
	p =	0.00	0.00	<b>0.00</b>	0.01	<b>0.00</b>
Q8	r =	<b>0.55</b>	<b>0.40</b>	<b>0.57</b>	<b>0.40</b>	0.31
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.00
Q9	r =	<b>0.51</b>	<b>0.41</b>	<b>0.62</b>	0.32	0.34
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.00	0.00
Q10	r =	<b>0.43</b>	0.36	<b>0.48</b>	<b>0.57</b>	0.23
	p =	<b>0.00</b>	0.00	<b>0.00</b>	<b>0.00</b>	0.00
Q11	r =	<b>0.50</b>	0.39	<b>0.43</b>	<b>0.92</b>	0.37
	p =	<b>0.00</b>	0.00	<b>0.00</b>	<b>0.00</b>	0.00
Q12	r =	<b>0.64</b>	<b>0.47</b>	<b>0.46</b>	<b>0.94</b>	0.41
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.00
Q13	r =	<b>0.75</b>	<b>0.46</b>	<b>0.59</b>	<b>0.63</b>	<b>0.45</b>
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Q14	r =	<b>0.55</b>	0.34	0.28	<b>0.47</b>	0.35
	p =	<b>0.00</b>	0.00	0.00	<b>0.00</b>	0.00
Q15	r =	<b>0.58</b>	<b>0.50</b>	<b>0.40</b>	0.17	0.35
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.01	0.00
Q16	r =	<b>0.49</b>	0.80	<b>0.41</b>	0.36	0.35
	p =	<b>0.00</b>	0.00	<b>0.00</b>	0.00	0.00
Q17	r =	<b>0.43</b>	<b>0.80</b>	0.35	0.30	0.33
	p =	<b>0.00</b>	<b>0.00</b>	0.00	0.00	0.00
Q18	r =	<b>0.49</b>	<b>0.78</b>	0.39	0.32	<b>0.40</b>
	p =	<b>0.00</b>	<b>0.00</b>	0.00	0.00	<b>0.00</b>
Q19	r =	<b>0.46</b>	<b>0.66</b>	<b>0.43</b>	0.38	0.26
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.00	0.00
Q20	r =	<b>0.47</b>	<b>0.59</b>	0.36	0.33	0.20
	p =	<b>0.00</b>	<b>0.00</b>	0.00	0.00	0.00
Q21	r =	<b>0.82</b>	<b>0.58</b>	<b>0.52</b>	<b>0.51</b>	<b>0.52</b>
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Q22	r =	<b>0.78</b>	<b>0.58</b>	<b>0.51</b>	<b>0.51</b>	<b>0.49</b>
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Q23	r =	<b>0.79</b>	<b>0.52</b>	<b>0.53</b>	<b>0.55</b>	<b>0.47</b>
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Q24	r =	<b>0.82</b>	<b>0.49</b>	<b>0.54</b>	<b>0.57</b>	<b>0.47</b>
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Q25	r =	<b>0.73</b>	<b>0.47</b>	<b>0.45</b>	<b>0.46</b>	<b>0.46</b>
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Q26	r =	<b>0.57</b>	<b>0.46</b>	0.38	<b>0.41</b>	<b>0.94</b>
	p =	<b>0.00</b>	<b>0.00</b>	0.00	<b>0.00</b>	<b>0.00</b>
Q27	r =	<b>0.53</b>	0.36	0.22	0.37	<b>0.90</b>
	p =	<b>0.00</b>	0.00	0.00	0.00	<b>0.00</b>
Q28	r =	<b>0.50</b>	<b>0.41</b>	0.25	0.31	<b>0.92</b>
	p =	<b>0.00</b>	<b>0.00</b>	0.00	0.00	<b>0.00</b>
Q29	r =	<b>0.50</b>	<b>0.44</b>	0.31	0.30	<b>0.85</b>
	p =	<b>0.00</b>	<b>0.00</b>	0.00	0.00	<b>0.00</b>
Q30	r =	<b>0.50</b>	<b>0.44</b>	0.31	0.30	<b>0.85</b>
	p =	<b>0.00</b>	<b>0.00</b>	0.00	0.00	<b>0.00</b>

(With the bold letters marked the statistical significant correlation.  $p < 0.05$ ).

**Table 2:** Reliability of FOSQ. Presented the coefficient-alpha with which each question individually contributed to the reliability of the subscale it describes.

	Mean ± sd	Corrected item-Total correl.	Alpha-if item deleted
<b>General productivity</b>		<b>Alpha = 0.7502</b>	<b>Standardized item alpha = 0.7646</b>
Q1	3.2 ± 0.98	0.413	0.731
Q2	3.77 ± 0.73	0.336	0.743
Q3	2.56 ± 1.66	0.462	0.727
Q4	2.91 ± 1.37	0.467	0.720
Q8	3.03 ± 1.45	0.531	0.707
Q9	2.88 ± 1.51	0.529	0.707
Q10	3.63 ± 0.87	0.483	0.723
Q11	3.48 ± 0.85	0.456	0.727
<b>Social outcome</b>		<b>Alpha = 0.7644</b>	<b>Standardized item alpha = 0.7644</b>
Q12	3.34 ± 0.98	0.618	-
Q13	3.38 ± 0.98	0.618	-
<b>Activity level</b>		<b>Alpha = 0.8289</b>	<b>Standardized item alpha = 0.8582</b>
Q5	3.12 ± 1.45	0.529	0.813
Q14	3.54 ± 0.93	0.471	0.818
Q15	2.01 ± 1.78	0.429	0.836
Q16	2.7 ± 1.44	0.493	0.818
Q22	3.12 ± 1.03	0.685	0.797
Q23	3.08 ± 0.93	0.654	0.803
Q24	3.41 ± 0.89	0.651	0.804
Q25	2.89 ± 0.83	0.645	0.806
Q26	2.75 ± 1.4	0.575	0.806
<b>Vigilance</b>		<b>Alpha = 0.7312</b>	<b>Standardized item alpha = 0.7970</b>
Q6	2.79 ± 1.52	0.501	0.688
Q7	3.27 ± 2.93	0.29	0.799
Q17	2.43 ± 1.65	0.575	0.669
Q18	2.71 ± 1.64	0.589	0.666
Q19	2.92 ± 1.09	0.532	0.695
Q20	2.68 ± 1.6	0.427	0.703
Q21	2.9 ± 1.03	0.601	0.687
<b>Intimate relationships and sexual activity</b>		<b>Alpha = 0.9361</b>	<b>Standardized item alpha = 0.9370</b>
Q27	3.15 ± 1.01	0.751	0.948
Q28	3.16 ± 0.99	0.871	0.908
Q29	3.35 ± 0.96	0.889	0.903
Q30	3.35 ± 0.96	0.889	0.903

## Reliability

The coefficient-Alpha correlation ranged from 0.290-0.889, indicate substantial contribution of the questions to the final reliability (Table 2). For Social Outcome, Vigilance, Intimate/Sexual activity the coefficient-Alpha was particularly high (Alpha > 0.800)-indicating strong reliability. For General Productivity (Alpha = 0.764) and Activity Level subscales (Alpha = 0.731) the reliability was moderate to strong.

## Achieving higher and lower floors (Floor and ceiling effects)

Almost uniform distribution of query values was ob-

served in subscales, but the upper threshold of the Intimacy/Sexual Activity was reached in 58.3% of patients. For the sum FOSQ, values ranged 21.8-3.6, showed a uniform overall fluctuation.

## Concurrent validity

SF-36 showed strong correlation with the FOSQ subscales (confidence intervals > 0.400), (Table 3). There was no correlation between vitality (SF-36) and intimacy/sexual activity (G-FOSQ), ( $r = 0.08$   $p = 0.39$ ).

## Discriminate validity

Based on the AHI index, patients were divided into

**Table 3:** Concurrent validity of FOSQ. A multivariate parametric correlation between SF-36 questionnaire (weighted in the Greek population) and FOSQ.

SF-36\ FOSQ		Activity	Vigilance	Gen. Product	Social OUTC	Intimacy sex act	SUMM
Physical functioning	r =	<b>0.67</b>	<b>0.53</b>	<b>0.53</b>	0.35	<b>0.50</b>	0.62
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.00	<b>0.00</b>	0.00
Role physical	r =	<b>0.51</b>	0.37	0.38	0.31	0.38	<b>0.49</b>
	p =	<b>0.00</b>	0.00	0.00	0.00	0.00	<b>0.00</b>
Bodily pain	r =	<b>0.42</b>	0.38	0.28	0.34	0.37	<b>0.48</b>
	p =	<b>0.00</b>	0.00	0.00	0.00	0.00	<b>0.00</b>
Social functioning	r =	<b>0.61</b>	<b>0.47</b>	<b>0.46</b>	<b>0.41</b>	<b>0.42</b>	<b>0.59</b>
	p =	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Mental health	r =	0.32	0.27	0.22	0.33	0.21	0.36
	p =	0.00	0.00	0.00	0.00	0.00	0.00
Role-emotional	r =	0.34	0.26	0.33	0.28	0.3	0.39
	p =	0.00	0.00	0.00	0.00	0.00	0.00
Vitality	r =	0.29	0.17	0.22	0.21	0.08	0.22
	p =	0.00	0.01	0.00	0.00	0.19	0.00
General health	r =	<b>0.43</b>	0.37	0.28	0.22	0.36	<b>0.44</b>
	p =	<b>0.00</b>	0.00	0.00	0.00	0.00	<b>0.00</b>

(With the bold letters marked the statistical significant correlation.  $p < 0.05$ ).

**Table 4:** Discriminate validity of FOSQ, based on ESS. A scale rating of up to 11 ( $ESS < 11$ , Group 1) indicates a low incidence of daytime sleepiness, while larger values indicate a high incidence of daily sleepiness ( $ESS \geq 11$ , Group 2).

FOSQ	ESS	n	Mean $\pm$ sd	
Activity	ESS < 11	222	3.1 $\pm$ 0.7	$p < 0.001$
	ESS $\geq$ 11	75	2.5 $\pm$ 0.8	
Vigilanc	ESS < 11		2.9 $\pm$ 1	$p < 0.001$
	ESS $\geq$ 11		2 $\pm$ 1.1	
Gen. prod	ESS < 11		3.3 $\pm$ 0.9	$p < 0.001$
	ESS $\geq$ 11		2.7 $\pm$ 0.8	
Soc. Out	ESS < 11		3.5 $\pm$ 0.8	$p < 0.001$
	ESS $\geq$ 11		3.1 $\pm$ 0.9	
Sex. resp	ESS < 11		2.9 $\pm$ 1.3	$p = 0.001$
	ESS $\geq$ 11		2.3 $\pm$ 1.4	
Summ	ESS < 11		15.8 $\pm$ 3.7	$p = 0.007$
	ESS $\geq$ 11		12.8 $\pm$ 3.8	

(The statistical significant difference is  $p < 0.05$ ).

three severity groups of OSAS. Only the Vigilance subscale showed difference between moderate and severe OSAS patients ( $2.8 \pm 1.1$  vs.  $2.4 \pm 1.25$ ,  $p = 0.04$ ). Significant differences found in all G-FOSQ subscales between the two groups, with higher values observed in the group with  $ESS < 11$  (Table 4). Based on the SDS, our patients were classified into only the first two categories; normal subjects and patients suffered from low anxiety symptoms, but no differences were found between the G-FOSQ subscales.

## Discussion

The application of the FOSQ in non-English speaking

countries requires linguistic adaptation together with a re-examination of its validity. Several language versions of the FOSQ including Norwegian (N-FOSQ) [15], Spanish [16], Swedish (S-FOSQ) [17], Thai [18] and Korean [19] have been recently evaluated in patients with sleep disorders, especially with OSAS. The G-FOSQ has produced comparatively similar good results. The stability of structures and the liability of the G-FOSQ (0.913) was found to be similar to the global score (0.94) [4]. The fluctuations of individual subscales are also excellent (0.713-0.936) similar to K-FOSQ (0.80-0.94), N-FOSQ (0.66-0.96) [15] and Turkish versions (T-FOSQ) [20]. A tendency of FOSQ to show no correlation with the AHI scores, as described both in K-FOSQ [19] and Thai-FOSQ [18], was also found.

The confirmation that the FOSQ measures the effects of functional status has already been shown from Weaver, et al. [21] achieving the desired correlation with SIP [21] and SF-36 [8]. In accordance, we found moderate correlation with all subscales of SF-36. However, there was no correlation between intimacy/sexual activity (G-FOSQ) and the vitality (SF-36). The T-FOSQ [20] excluded this subscale because their patients found inappropriate answering these questions for religion reasons. Additionally, data showed [22] that patients over 65 years tend not to fill out these questions (30.4% filled in), therefore any correlation lack reliability. We are not excluding these questions from the G-FOSQ as the internal validity of the questions of this subscale (Q27-Q30) were high ( $r = 0.85-0.90$ ,  $p = 0.001$ ), which is the most important factor for this decision. Perhaps, the lack of correlation ought to racial mentality differentiation in the Greek population regarding the perception of vital-



ity and its harmonization with sexual activity. Gender, age, income, married out of love and being still in love with the partner were all significantly associated with sexual interest and behaviors in Greek people [23] but not any kind of chronic disease that they suffer. Only, in the Korean translation (K-FOSQ) the evaluation suggested that 5 questions had to be removed as unrelated to the overall reliability of the questionnaire.

The daily sleepiness is the key for subjective evaluation of OSAS severity. We found, in agreement with literature [16], excessive decreasing scores of G-FOSQ in patients with ESS > 11. As depression constitutes an important factor “statistical noise” analyzes questionnaires object the quality of life [24]. We found no correlation, but the vigilance subscale appeared positive correlation with SDS, fact that until now has been shown in patients with Restless Legs Syndrome [25].

In conclusion, the results from this study provide that the G-FOSQ is a reliable and valid instrument for assessing functional outcome in Greek Population with daytime sleepiness.

## Compliance with Ethical Standards

### Conflict of interest

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

### Research involving human participants

The ethical committees both of NHS Sleep Lab, Geniko Nosokomeio Thessalonikes 'Agius Pavlos', Thessaloniki, Greece and NHS Sleep LAB, Pulmonary Clinic, Geniko Nosokomeio Thessalonikes 'Georgios Papanikolaou', Thessaloniki, Greece approve the study as it was a non-interventional study and personal data were secured by the digital system according to GDPR (General Data Protection Regulation, -2016/679).

### Informed consent

All patients before starting to fill the questionnaires signed an inform concern-given permission to us for using their data for searching purposes.

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