The Danish translation and validation of the Berlin Questionnaire for sleep apnoea

Lauritzen, Elisabeth; Kørvel-Hanquist, Asbjørn; Homøe, Preben

Published in:
Danish Medical Journal

Publication date:
2018

Document version
Publisher's PDF, also known as Version of record

The Danish translation and validation of the Berlin Questionnaire for sleep apnoea

Elisabeth Lauritzen, Asbjørn Kørvel-Hanquist & Preben Homøe

ABSTRACT

INTRODUCTION: Obstructive sleep apnoea (OSA) is an increasing health problem related to cardiovascular disease, poor quality of life, daytime sleepiness and un-restorative sleep with an estimated prevalence up to 20% in the adult population. Approximately 82% of men and 93% of women with moderate to severe OSA remain undiagnosed. Relevant, fast, accurate and cost-effective screening methods are essential.

The aim of this study was to translate and validate the Danish version of the Berlin Questionnaire (BQ), and to investigate if the questionnaire can be used for screening of OSA in a Danish population.

METHODS: The BQ was translated into Danish according to guidelines producing the Danish Berlin Questionnaire (DBQ). The study population included 206 adult patients referred to the Sleep Clinic of Zealand University Hospital, Denmark, on suspicion of OSA.

RESULTS: 69.4% were males, 53.3% were obese (BMI › 30), the mean BMI was 32.01. A total of 135 patients had hypertension (65.5%). Apnoea/hypopnoea Index (AHI) ≥ 15 was present in 141 of 206 patients (68.4%). We observed a sensitivity of the DBQ of 84% and a positive predictive value of 69%.

CONCLUSIONS: We have successfully translated and partially validated the DBQ for OSA. Our study showed that the DBQ is useful for screening of Danish patients suspected of OSA. Further studies with improved screening methods and further development of questionnaires are recommended.

FUNDING: none.

TRIAL REGISTRATION: The study was approved by the Danish Data Protection Agency..

Obstructive sleep apnoea (OSA) is a common sleep-related breathing disorder with an estimated prevalence of up to 20% in adults [1-4]. Up to 82% of men and 93% of women with moderate to severe OSA remain undiagnosed [5]. The prevalence of OSA varies by age, sex and Body-Mass Index (BMI), with a prevalence of 49% with advanced age and up to 45% in obese individuals [6, 7].

OSA is associated with an increased risk of hypertension, cardiovascular disease, low quality of life, metabolic syndrome, diabetes and all-cause mortality [4, 8]. Risk factors are obesity, abnormalities in the upper respiratory airways, alcohol overuse and smoking [2, 4]. Symptoms are daytime sleepiness, automobile or work-related accidents, personality change or cognitive difficulties [1].

The Apnoea/Hypopnoea Index (AHI) determines the presence or absence of OSA [2], which is divided into three groups; mild (AHI 5- <15), moderate (AHI ≥ 15-30) and severe (AHI ≥ 30) [1, 2]. According to international guidelines, moderate to severe OSA (AHI ≥ 15) is considered clinically relevant and requires treatment [9, 10]. The national threshold for treatment in Denmark is AHI ≥ 15 [11].

The gold standard for diagnosing OSA is polysomnography (PSG) [1, 4]. Cardiac respiratory monitoring (CRM) is often used as an equivalent gold standard because it does not require hospital admission and is more cost-effective [2, 12, 13].

The Berlin Questionnaire (BQ) was an outcome of the 1996 Conference On Sleep in Primary Care [14].

The BQ consists of ten questions divided into three categories [8]. Category 1 consists of an introductory question followed by four questions about snoring behaviour. A high risk is defined as persistent symptoms (>3-4 times/week) in two or more questions. Category 2 contains two questions about daytime sleepiness, followed by two questions on sleepiness when driving. Persistent (> 3-4 times/week) daytime sleepiness and/or sleepiness while driving defines a high risk. Category 3 concerns history of high blood pressure. A high risk is defined as history of high blood pressure or BMI > 30 kg/m^2 [14]. The patient is at high risk of OSA if the individual scores a positive/high risk on a least two of the three categories [8, 14].

This study aimed to translate and validate the Berlin Questionnaire on sleep apnoea into Danish and to test the questionnaire for screening of OSA in an adult Danish population.

METHODS

Translation

The BQ was translated according to the 5-stage guidelines presented by Beaton et al [15].

Stage 1 - the original questionnaire was translated from English into Danish by two independent bilingual individuals. Stage 2 - the two translations were synthe-

ORIGINAL ARTICLE

Department of Otorhinolaryngology and Maxillofacial Surgery, Zealand University Hospital, Denmark

Dan Med J 2018;65(9):A5502

FIGURE 1

The translated Danish Berlin Questionnaire

BERLIN SPØRGESKEMA

Søvnapnø

Højde (cm) _____ Vægt (kg) _____

Alder (år) _____ Mand / Kvinde

Sæt kryds ud for det rigtige svar til hvert spørgsmål

KATEGORI 1

1. Snorker du?

- ☐ a. Ja
- ☐ b. Nej
- ☐ c. Ved ikke

Hvis du svarede ja:

2. Din snorken er:

- ☐ a. Lidt højere end din vejrtrækning
- ☐ b. Så højt som tale
- ☐ c. Højere end tale

Hvor ofte snorker du?

- ☐ a. Næsten hver dag
- ☐ b. 3-4 gange om ugen
- ☐ c. 1-2 gange om ugen
- ☐ d. 1-2 gange om måneden
- ☐ e. Sjældent eller aldrig

Har din snorken generet andre?

- ☐ a. Ja
- ☐ b. Nej
- ☐ c. Ved ikke

Har andre observeret at du holder op med at trække vejret under søvn?

- ☐ a. Næsten hver dag
- ☐ b. 3-4 gange om ugen
- ☐ c. 1-2 gange om ugen
- ☐ d. 1-2 gange om måneden
- ☐ e. Sjældent eller aldrig

KATEGORI 2

Hvor ofte føler du dig træt eller udmattet efter søvn?

- ☐ a. Næsten hver dag
- ☐ b. 3-4 gange om ugen
- ☐ c. 1-2 gange om ugen
- ☐ d. 1-2 gange om måneden
- ☐ e. Sjældent eller aldrig

I dine vågne timer, hvor ofte føler du dig træt, udmattet eller ikke på toppen?

- ☐ a. Næsten hver dag
- ☐ b. 3-4 gange om ugen
- ☐ c. 1-2 gange om ugen
- ☐ d. 1-2 gange om måneden
- ☐ e. Sjældent eller aldrig

Er du nogensinde faldet i søvn, eller været ved at falde i søvn, mens du kørte i bil?

- ☐ a. Ja
- ☐ b. Nej

Hvis du svarede ja:

Sker det ofte?

- ☐ a. Næsten hver dag
- ☐ b. 3-4 gange om ugen
- ☐ c. 1-2 gange om ugen
- ☐ d. 1-2 gange om måneden
- ☐ e. Sjældent eller aldrig

KATEGORI 3

Har du forhøjet blodtryk?

- ☐ a. Ja
- ☐ b. Nej
- ☐ c. Ved ikke

sised, producing one translation. Stage 3 - the questionnaire was translated back into English by two other independent bilingual individuals. Stage 4 - the original questionnaire and the translated version were compared and subjected to a committee review, yielding a single Danish pre-version. Stage 5 - the Danish BQ (DBQ) was pretested on 20 patients who met the study's inclusion criteria. The DBQ was then re-evaluated for any linguistic misinterpretations, and the final DBQ was agreed upon (**Figure 1**).

Validation

The study population consisted of patients referred to the Sleep Clinic of Zealand University Hospital, Denmark, on suspicion of OSA from 1 December 2016 to 30 April 2017. Inclusion criteria were: suspicion of OSA, no previous diagnosed OSA, completed overnight CRM and DBQ. Patients who were unable to read or understand Danish were excluded.

A total of 208 patients met the inclusion criteria, and 206 completed the DBQ and were enrolled in the study.

Statistics

Baseline characteristics (age, sex, height, weight, BMI and AHI score) were described as mean ± 1 standard deviation (SD) for proportions with 95% confidence intervals (CI). BMI was calculated based on height and weight (kg/m^2).

The risk of OSA determined by the DBQ was compared with the AHI results. Statistical analyses were generated using SAS software (SAS Institute Inc. SAS Cary, North Carolina, USA).

Patients were divided into two categories; »High OSA risk« if the DBQ score was ≥ 2 positive categories, and »Low OSA risk« if ≤ 1 positive category.

Moderate to severe OSA (AHI ≥ 15) is considered clinically relevant and requires treatment; therefore, the cut-off score was AHI < 15 and AHI ≥ 15.

The sensitivity, specificity and accuracy were calcu-

lated using 2 × 2 contingency tables. Positive predictive value (PPV) and negative predictive value (NPV) were calculated to describe performance and accuracy. To assess the value of performing the DBQ, we calculated the positive likelihood ratio (LR+) and the negative likelihood ratio (LR-). Furthermore, the reliability and consistency of the DBQ were tested using Cronbach's alpha (tau-equivalent reliability).

Trial registration: The study was approved by the Danish Data Protection Agency.

RESULTS

The BQ was successfully translated into Danish, yielding the final DBQ (Figure 1).

In total, 206 patients completed the DBQ and underwent overnight diagnostic CRM. The characteristics are given in **Table 1**. A total of 110 (53.3%) patients were obese (BMI > 30) and 135 had hypertension (65.5%).

AHI ≥ 15 was present in 141 patients (68%), the total mean AHI of the population was 32.9. DBQ identified 173 of 206 (84%) as having a »high risk« of OSA and 33 (16%) as having a »low risk«. When screening for OSA with AHI ≥ 15 and »high risk« (DBQ ≥ 2 positive categories), the sensitivity was 0.84 (95% confidence interval (CI) 0.78-0.90), and the specificity was 0.17 (95% CI 0.08-0.26) (**Table 2**).

Of 173 »high risk« patients, 119 had AHI ≥ 15, yielding a PPV of 0.69 (95% CI 0.61-0.75). The proportion identified by the DBQ as having a »low risk« with AHI < 15 was 11 of 33, resulting in a NPV of 0.33 (95% CI 0.17-0.51). Fifty-four of 65 patients with an AHI < 15 were identified as »high risk« patients, estimating a false positive probability of 0.83 (95% CI 0.73-0.92). Twenty-two of 141 had an AHI ≥ 15 and were classified as having a »low risk« of OSA, producing a false negative probability of 0.16 (95% CI 0.09-0.22). The accuracy of the DBQ to screen for OSA was 0.63 (95% CI 0.56-0.70) (**Figure 2**).

The LR+ for OSA with an AHI ≥ 15 was 1.02, and the LR- was 0.92.

The internal consistency of categories one and two, calculated by Cronbach's alpha coefficient, were 0.63 and 0.67, respectively. Cronbach's alpha coefficient for category three was irrelevant since it consists of a single question.

DISCUSSION

In this study, we have successfully translated the BQ according to guidelines [15]. Our study was in line with previous studies examining the sensitivity, specificity, PPV and NPV.

The BQ has the highest number of validation studies, although the reported sensitivity and specificity varies [16-18].

There are other questionnaires, e.g., the STOP-BANG questionnaire (SBQ) for detection of OSA that also show inconsistent sensitivity and specificity results [13, 16, 17, 19, 20].

We found an acceptable sensitivity of 0.84, which is consistent with previous studies where the sensitivity of the BQ ranged from 0.57 to 0.95 when tested in different populations [19, 17]. The rather high sensitivity of 0.84 in this study indicates that the DBQ is a reliable questionnaire for screening of patients suspected of OSA in a Danish population. We found the PPV to be 0.69. Combined with a sensitivity of 0.84, this indicates that if the DBQ is positive, i.e., a »high risk of OSA«, there is a 69% likelihood that an individual actually has OSA.

TABLE 1

Baseline characteristics of the study population (N = 206).

Males, n (%)	143 (69.4)
Age, mean ± 1 SD, yrs	52 ± 13.6
Height, mean ± 1 SD, m	1.76 ± 0.1
BMI, mean ±1 SD, kg/m²	32 ± 7.5
AHI, mean ± 1 SD	32.9 ± 27.5
AHI, n	
[0-5]	13
[5-15]	52
[15-30]	53
≥ 30	88
Total	206
DBQ-score, n	
High-risk: > 2 positive categories	173
Low-risk: < 1 positive category	33
Total	206

AHI = apnoea/hypopnoea index; DBQ = Danish Berlin Questionnaire; SD = standard deviation.

TABLE 2

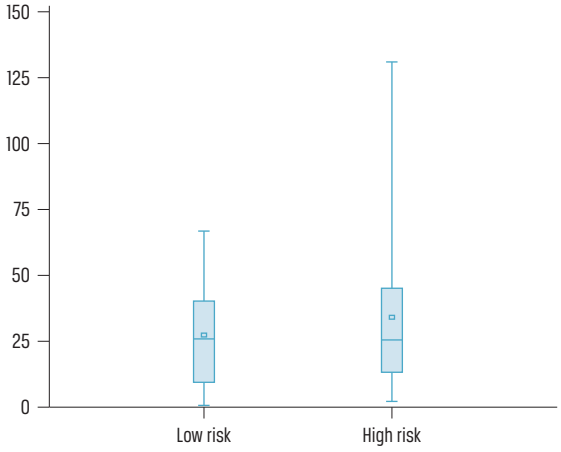
Contingency table: sensitivity, specificity, positive predictive value and negative predictive value of the Danish Berlin Questionnaire.

	n			
	low risk	**high risk**	**total**	**Mean (95% CI)**
AHI				
< 15	11	54	65	-
≥ 15	22	119	141	-
Total	33	173	206	-
DBQ				
Sensitivity	-	-	-	0.84 (0.78-0.90)
Specificity	-	-	-	0.17 (0.08-0.26)
Overall PPV	-	-	-	0.69 (0.61-0.75)
Overall NPV	-	-	-	0.33 (0.17-0.51)

AHI = apnoea/hypopnoea index; CI = confidence interval; DBQ = Danish Berlin Questionnaire; NPV = negative predictive value; PPV = positive predictive value.

FIGURE 2

Box-plot correlation between Apnoea/hypopnoea Index (AHI) ≥ 15 and Danish Berlin Questionnaire (DBQ) score: low-risk (i.e. ≤ 1) and high-risk (i.e. ≥ 2) score.



Outer lines: min./max. AHI-score. Blue-box: 25/75 percentile. Midlines: median/50 percentile. Small square: mean.

When comparing sensitivity, specificity, PPV and NPV of the BQ with those of the SBQ in studies on patients without history of sleep disorders, the results are very heterogeneous [16]. Abrishami et al [16] conducted a systematic review on questionnaires for OSA comparing the SBQ and the BQ in a study population without a history of sleep disorders with an (AHI ≥ 15). The SBQ had a sensitivity and a specificity of 0.93 and 0.43, and the PPV and NPV were 0.51 and 0.90, respectively. The BQ had a sensitivity in the 0.54–0.79 range, a specificity in the 0.50–0.97 range, a PPV of 0.50–0.97 and an NPV of 0.48–0.78. Bille et al translated and validated the SBQ in a Danish population of 43 patients and found the sensitivity and specificity to be 1.0 and 0.59, respectively [13].

Kørvel-Hanquist et al validated the Danish SBQ in a Danish population comprising 208 patients and found a high sensitivity of 0.98 and a specificity of only 0.09, with a corresponding PPV and NPV of 0.53 and 0.82, respectively [20]. These studies indicate that the SBQ is more valid in screening for OSA than the BQ.

A systematic review and meta-analysis of the validity of the BQ by Senaratna et al [17] including 35 BQ studies reported a pooled sensitivity for clinically relevant OSA (i.e. AHI ≥ 15) of 0.82, and a pooled specificity of 0.35-0.39. The included studies on the SBQ reported a higher sensitivity for clinically relevant OSA, but as for the BQ, most of these studies have not been conducted in the general population [17]. The variability in the diagnostic utility between the BQ and SBQ is probably due in part to differences in type of sleep study and the definitions and cut-off values of AHI indicating OSA.

Research directly comparing these two questionnaires is needed to determine how best to use one or both in the screening for OSA.

We found a low specificity of 0.17. Previous studies have reported the specificity of the BQ to fall in the 0.32-0.95 range [16]. The low specificity can be explained by the study population, which consisted of patients referred on suspicion of OSA. The proportion of patients in this study with AHI < 15 was 31.5% (65 of 206).

The false positive proportion of 0.83 indicates that many patients who do not suffer from OSA test as »high-risk« patients when subjected to the DBQ, and will therefore possibly be exposed to unnecessary testing, evaluation and use of medical resources. A total of 33 of the 206 patients tested as »low risk« according to the DBQ. Twenty-two of the 33 patients had an AHI ≥ 15, resulting in a false negative proportion of 67%.

When assessing the DBQ score, the clinical symptoms must also be considered. Therefore, if a patient with symptoms of OSA tests as »low risk«, further investigation with CRM is indicated.

OSA is a disease with well-known serious consequences. Therefore, the costs may seem to be of secondary importance when there are no risks associated with the diagnostic tests (CRM or PSG). In terms of OSA, rather than a high specificity, it is more important that a screening tool has a high sensitivity and does not miss patients with OSA.

Our investigation found a PPV of 0.69 indicating that if DBQ is positive, i.e., a »high risk of OSA«, there is a 69% likelihood that an individual actually has OSA. This shows that the DBQ can be an important screening tool for patients suspected of OSA.

The internal consistencies calculated by Cronbach's alpha coefficient were 0.63 and 0.67 for category one and two, respectively, indicating that snoring behaviour, daytime sleepiness/fatigue and drowsiness while driving are reliable elements in the measurement of OSA.

Our study shows that the DBQ has a high sensitivity for detection of clinically relevant OSA (AHI ≥ 15) in patients suspected of having OSA. The DBQ is simple and easy to understand, it can be done in a primary care setting and is inexpensive. The use of the DBQ could potentially identify many patients suffering from OSA, leading to their correct and quick diagnosis and treatment.

Limitations

Six of the included 206 patients (3%) did not have a driver's license/had never driven a motor vehicle, thus scoring zero points in questions about drowsiness while

driving. However, this did not change the internal consistency of the DBQ.

The expert committee revising the translation of the DBQ in stage four of the translation process and the pre-test results in stage five did not find test-retest crucial to the structure and contents of the questionnaire. The Danish translation of the questionnaire was found to be unambiguous. Test-retest is recommended in further studies to assess the reproducibility of the DBQ.

CONCLUSIONS

We have translated and partially validated the Danish version of the DBQ for sleep apnoea. Our study shows that the DBQ is useful for screening of Danish patients suspected of OSA, but not for those without OSA. Further studies conducted in the general population are needed.

The results of the DBQ are comparable to other studies, but improved screening methods and further development is needed. The potential effect of combined use of available questionnaires would be interesting to examine.

CORRESPONDENCE: *Elisabeth Lauritzen.*
E-mail: elisabethlauritzen@hotmail.com

ACCEPTED: 16 July 2018

CONFLICTS OF INTEREST: none. Disclosure forms provided by the authors are available with the full text of this article at www.danmedj.dk.

CORRECTIONS:

IN THE ARTICLE: "The Danish translation and validation of the Berlin Questionnaire for sleep apnoea" The following corrections has been made at 21th September 2018.

A NEW VERSION OF TABLE 2 HAS BEEN ADDED.

IN FIGURE 2 THE FIGURE TEXT HAS BEEN EDITED FROM "BOX-PLOT CORRELATION BETWEEN AHI ≥ 15 AND DBQ-SCORE: low-risk and high-risk" to: "Box-plot correlation between Apnoea/hypopnoea Index (AHI) ≥ 15 and Danish Berlin Questionnaire (DBQ) score: low-risk (i.e. ≤ 1) and high-risk (i.e. ≥ 2) score."

THE FOLLOWING PARAGRAPH HAS BEEN DELETED FROM THE PARAGRAPH "LIMITATIONS" AND ADDED TO THE PARAGRAPH "DISCUSSION": "Our study shows that the DBQ has a high sensitivity for detection of clinically relevant OSA (AHI ≥ 15) in patients suspected of having OSA. The DBQ is simple and easy to understand, it can be done in a primary care setting and is inexpensive. The use of the DBQ could potentially identify many patients suffering from OSA, leading to their correct and quick diagnosis and treatment."

LITERATURE

1. Arnold J, Sunilkumar M, Krishna V, et al. Obstructive sleep apnea. J Pharm Bioallied Sci 2017;9:121-5.
2. Jennum P, Tønnesen P. Obstruktiv søvnapnø-syndrom. Ugeskr Laeger 2014;176:1032-4.
3. Peppard PE, Young T, Barnet JH et al. Increased prevalence of sleep-disordered breathing in adults. Am J Epidemiol 2013;177:1006-14.
4. Jordan AS, Mcsharry DG, Malhotra A. Adult obstructive sleep apnoea. Lancet 2014;383:736-47.
5. Young T, Evans L, Finn L et al. Estimation of the clinically diagnosed proportion of sleep apnea syndrome in middle-aged men and women. Sleep 1997;20:705-6.
6. Heinzer R, Vat S, Marques-Vidal P et al. Prevalence of sleep-disordered breathing in the general population: the HypnoLaus study. Lancet Respir 2015;3:310-8.
7. Young T, Palta M, Dempsey J et al. The occurrence of sleep-disordered breathing among middle-aged adults. N Engl J Med 1993;29:1230-5.
8. Netzer NC, Hoegel JJ, Loube D et al. Prevalence of symptoms and risk of sleep apnea in primary care. Chest 2003;124:1406-14.
9. Kushida C, Littner M, Hirshkowitz M et al. Practice parameters for the use of continuous and bilevel positive airway pressure devices to treat adult patients with sleep-related breathing disorders. Sleep 2006;29:375-80.
10. Barnett D, Black D, Buckley B et al. Continuous positive airway pressure for the treatment of obstructive sleep apnoea/hypopnoea syndrome. National Institute for Health and Care Excellence. https://www.nice.org.uk/guidance/ta139/resources/continuous-positive-airway-pressure-for-the-treatment-of-obstructive-sleep-apnoeahypopnoea-syndrome-pdf-82598202209221 (25 May 2018).
11. Løvschall C, Søbjerg L, Pedersen M et al. Medicinsk teknologivurdering af obstruktiv søvnapnø - Sammenfatning. 2013. http://www.cfk.rm.dk/files/Sundhed/CFK/Udgivelser/MTV og sundhedstjenesteforskning/Publikationer/MTV_søvnapnø_sammenfatning_2013_05.pdf (25 May 2018).
12. Collop NA, Anderson WM, Boehlecke B et al. Clinical guidelines for the use of unattended portable monitors in the diagnosis of obstructive sleep apnea in adult patients. Portable Monitoring Task Force of the American Academy of Sleep Medicine. J Clin Sleep Med 2007;3:737-47.
13. Bille J, Bille-Hasselstrøm C, Petersen CG. Translation and validation of the Stop-Bang Questionnaire for obstructive sleep apnoea into Danish. Dan Med J 2015;62:A5158.
14. Netzer NC, Stoohs RA, Netzer CM et al. Using the Berlin Questionnaire to identify patients at risk for the sleep apnea syndrome. Ann Intern Med 1999;5:485-91.
15. Beaton DE, Bombardier C, Guillemin F et al. Guidelines for the process of cross-cultural adaptation of self-report measures. 2000;25:3186-91.
16. Abrishami A, Khajehdehi A, Chung F. A systematic review of screening questionnaires for obstructive sleep apnea. Can J Anesth 2010;57:423-38.
17. Senaratna CV, Perret JL, Matheson MC et al. Validity of the Berlin questionnaire in detecting obstructive sleep apnea: a systematic review and meta-analysis. Sleep Med Rev 2017;36:116-24.
18. Bouloukaki I, Komninos ID, Mermigkis C et al. Translation and validation of Berlin questionnaire in primary health care in Greece. BMC Pulm Med 2013;13:1.
19. Westlake K, Polak J. Screening for obstructive sleep apnea in type 2 diabetes patients - questionnaires are not good enough. Front Endocrinol 2016;7:10-2.
20. Kørvel-Hanquist A, Andersen IG, Lauritzen SEK et al. Validation of the Danish STOP-Bang obstructive sleep apnoea questionnaire in a public sleep clinic. Dan Med J 2018;65:A5434.