

## DEVELOPMENT AND VALIDATION OF A QUALITY-OF-LIFE MEASURE FOR MEN WITH NOCTURIA

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### ABSTRACT

**Objectives.** To develop and assess the psychometric properties of a short self-report nocturia-specific Quality-of-Life (QOL) questionnaire.

**Methods.** The Nocturia Quality-of-Life questionnaire (N-QOL) was developed using focus group interviews with men experiencing nocturia. To refine it further and psychometrically validate the questionnaire, 107 men with nocturia (from four urology clinics in the United Kingdom) completed the pilot N-QOL, along with measures of health status and sleep quality. To assess reproducibility, men from one clinic completed the pilot N-QOL again at 1 week.

**Results.** After standard item reduction analyses, 18 items were dropped from the pilot questionnaire. The psychometric properties of the remaining 13-item instrument were tested in accordance with standard criteria. Factor analysis identified two subscales, sleep/energy and bother/concern, loading at 0.5 and greater. The N-QOL overall score and subscales proved to be internally consistent ( $\alpha = 0.84$  to  $0.90$ ) and reproducible (intraclass correlation coefficient =  $0.74$  to  $0.82$ ). N-QOL scores correlated with sleep quality ( $P < 0.01$ ) as measured by the Pittsburgh Sleep Quality Index and energy/vitality and social functioning ( $P < 0.01$ ) as measured by the SF-36 Health Survey, demonstrating good convergent validity. The N-QOL also demonstrated statistically significant differences between the scores of those experiencing one, two, and three or more episodes of nocturia on an average night, indicating excellent discriminant validity.

**Conclusions.** These analyses provide support for the psychometric validity of the N-QOL for use in a male population with nocturia. UROLOGY 63: 481–486, 2004. © 2004 Elsevier Inc.

Nocturia is a common symptom in the elderly and is characterized by the need to wake up at night to void.<sup>1</sup> It is frequently associated with lower urinary tract abnormalities, such as benign prostatic obstruction or overactive bladder, but ex-

cess nocturnal urine production may also be implicated.<sup>2</sup> The incidence of nocturia increases with age, with rates ranging from 30% for men aged 50 to 54 years to 60% for men in their 70s.<sup>3</sup>

Nocturia has been identified as having a significant impact on a person's health-related quality of life (QOL).<sup>4,5</sup> Nocturnal micturition has been found to be associated with poor sleep quality, increased daytime fatigue, and lower levels of general well-being.<sup>6,7</sup> This impact may also extend to partners, who can experience sleep disturbance as a result of living with a person who has nocturia.<sup>8</sup> The effect of nocturia on the quality of a patient's life is often the key driver for seeking healthcare intervention and dictates the choice of treatment options. Therefore, it is important that outcome measures for nocturia not only measure symptom frequency, but also evaluate patients' perception of his condition and associated impacts. Currently, no validated disease-specific instruments are avail-

*This research was funded by Pfizer Global Pharmaceuticals, Sandwich, United Kingdom.*

*P. Abrams, M. J. Drake, R. P. MacDonagh, and J. G. Noble are study investigators funded by the sponsor. M. L. Martin is a paid consultant to the sponsor.*

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*Submitted: July 29, 2003, accepted (with revisions): October 2, 2003*

able that examine the QOL impact of nocturia alone.

## MATERIAL AND METHODS

### INSTRUMENT DEVELOPMENT

The Nocturia Quality-of-Life questionnaire (N-QOL) was developed in accordance with the needs-based model proposed by Hunt *et al.*,<sup>9</sup> which stresses the importance of patient-based information about QOL impacts. This approach has been shown to increase the content validity and overall psychometric performance of the resulting health-related QOL measures. After a review of the literature, focus groups were held with four groups of 7 to 8 men with nocturia to discuss the impact of nocturia on their QOL. Because the N-QOL was intended for use across multiple cultures, these focus groups were conducted across three geographic regions: two in the United States, one in Eastern Europe (Slovakia), and one in Western Europe (Italy), with additional input from a clinician in the Far East (Japan). These sessions were recorded and transcribed, with the non-English versions translated into English. A panel of QOL experts and urologists reviewed the transcripts and selected key concepts for development into potential items. The resultant questionnaire was pilot tested with 5 men in the United States to ensure clarity, relevance, and ease of use. After small changes, the pilot N-QOL consisted of 31 items with a 5-point Likert-like response scale. Items covered psychological distress, sleep, interference with habits, impact on relationships, limitations on activities and travel, physical energy, concentration, and safety. The instrument included instructions for self-administration and had a recall period of 2 weeks. Items were scored from 0 to 4, with a greater score indicating better QOL. Scores were then summed and transformed into a standardized scale from 0 to 100.

### PARTICIPANTS AND PROCEDURES

To test the psychometric properties of the pilot N-QOL, men with a history of nocturia were recruited from four urology clinics in the United Kingdom. The local independent research ethics committees at all sites had approved participation in the study. Criteria for participation included nocturia at least twice per night (although 5 patients with nocturia once per night were allowed at each center for discriminant validity), no history of sleep disorders, and no significant psychiatric illness. After providing informed consent, patients attended an appointment at their urology clinic to complete a series of questionnaires. In the center selected to test reproducibility, participants returned to the clinic 8 days after their first visit to complete their second administration of the N-QOL, along with an item on global rating of change in nocturia.

### INSTRUMENTS

In addition to the pilot N-QOL, all participants completed three additional measures, which were used to assess convergent validity (the extent to which the N-QOL was associated with related measures). These were the International Prostate Symptom Score (IPSS) one-week version, the SF-36 Health Survey (SF-36), and the Pittsburgh Sleep Quality Index (PSQI).

The IPSS is a seven-item self-report questionnaire that assesses the severity of lower urinary tract symptoms associated with the prostate.<sup>10</sup> An additional item, scored separately, measures the QOL impact of these symptoms.

The SF-36 is a 36-item, self-administered, generic health status questionnaire comprising eight multi-item subscales, including energy/vitality and social functioning.<sup>11</sup>

The PSQI is a 19-item, self-administered questionnaire to assess sleep quality.<sup>12</sup> The items form seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction.

### ITEM REDUCTION

Standard item reduction analyses were run on the 31 items of the pilot N-QOL. Items were considered for reduction if they were greatly skewed (ceiling effect greater than 50%), had high levels of missing data (greater than 5%), low item-total correlations (less than 0.4), high item-to-item correlations (greater than 0.7), or failed to load onto any factor (less than 0.4). If any of the items in the scale were of concern against these criteria, their qualitative characteristics were assessed with reference to the conceptual model to assist in the decision to drop the item before the validation analyses.

### EVALUATION OF PSYCHOMETRIC PROPERTIES

The standard procedures and instrument review criteria developed by the Scientific Advisory Committee of the Medical Outcomes Trust were used to evaluate the psychometric properties of the N-QOL.<sup>13</sup> After item reduction, an exploratory factor analysis was performed on the remaining items to identify potential subscales.

The internal consistency reliability of the N-QOL, which is the degree of association between the items and subscale scores, was estimated using Cronbach's alpha coefficient. A minimal correlation of 0.70 was necessary to claim the instrument and its subscale scores were internally consistent, with a preferred alpha value between 0.80 and 0.90.<sup>14</sup> Test-retest reliability, indicating reproducibility, was assessed using patients from one center who reported no change in their nocturia status during the 8-day test-retest period. An intraclass correlation coefficient was calculated to determine stability of the scores over time. The intraclass correlation coefficient corrects for the lack of independence between measurement intervals (minimal acceptable level 0.70).<sup>15</sup>

Convergent validity was determined by comparing the N-QOL scores with the scores on the other logically related measures. A correlation of 0.4 or greater was taken as evidence of convergent validity. It was hypothesized that the scores on the N-QOL would be associated with the scores on the PSQI, the energy/vitality and social functioning subscales of the SF-36, and the IPSS QOL measure. Discriminant validity, which is the ability to discriminate between known-groups, was determined using analysis of variance to compare the scores of those experiencing one, two, and three or more episodes of nocturia on an average night.

## RESULTS

### PATIENT CHARACTERISTICS

The study included 107 men with a mean age of 68.2 years (range 32 to 88). Of the 107 men, 85% reported waking up to urinate twice or more per night, and 75.7% had experienced nocturia for more than 1 year. The most common causes of nocturia (as reported by the investigators) were benign prostatic obstruction (36.4%) and overactive bladder (6.5%).

### ITEM REDUCTION

Although by current definition any number of voids during the night is considered nocturia,<sup>1</sup> nocturia once per night could be considered nor-

**TABLE I. Exploratory factor analysis of the N-QOL**

N-QOL Items	Factor 1: Sleep/Energy	Factor 2: Bother/Concern	Variance (%)
Has made me feel generally low in energy the next day	0.84		48.27
Has made me less productive the next day	0.84		
Has made it difficult for me to concentrate the next day	0.81		
Has caused me to participate less in activities I enjoy	0.65		12.77
Has required me to nap during the day	0.56		
Has made it difficult for me to get enough sleep at night	0.64	0.59	
Worried that this condition will get worse in the future		0.86	
Worried that there is no effective treatment for this condition		0.84	
Preoccupied about having to get up at night to urinate		0.71	
Concerned that I am disturbing others in the house because of having to get up at night to urinate		0.59	
Has caused me to be careful about when or how much I drink		0.54	0.54
Overall, how bothersome has having to get up at night to urinate been during the past 2 weeks?		0.54	

KEY: N-QOL = Nocturia Quality of Life Questionnaire.  
 Extraction method: Principal Component Analysis; rotation method: Varimax with Kaiser normalization.  
 Rotation converged in three iterations.

mal, because it is so common and is not highly bothersome. However, having to get up two or more times per night is extremely bothersome to patients and is thus considered symptomatic.<sup>16</sup> Consequently, only those who reported two or more episodes of nocturia on an average night were included in the item reduction analyses (n = 85) to ensure item reduction was based on results from those actually having clinically significant symptomatic nocturia.

Eight items demonstrated a ceiling effect and one had more than 5% missing data, suggesting they were not especially pertinent to this population. Seventeen items had item-to-item correlations greater than 0.7, indicating some conceptual overlap. No item had an item-total correlation or factor loading of less than 0.4. In total, 18 items were dropped from the scale on the basis of the item reduction criteria, the conceptual needs-based model, and issues identified as important from published reports and from the focus groups. The eight items dropped because of high ceiling effects included items related to difficulties in relationships and physical safety and injury concerns. The item dropped because of high missing data concerned interference with sex life, which also exhibited a ceiling effect. Re-examination of the focus group transcripts confirmed that all these items were not greatly significant to this population. Nine other items were removed because of conceptual overlap and varying degrees of redundancy with the content in other items. The final N-QOL consisted of 13 items, with 12 items directly related to nocturia and 1 global QOL item (see Appendix).

#### FACTOR ANALYSIS

The global QOL item was not included in the factor analysis because it does not relate specifically to nocturia and should be scored separately.

A principal components analysis with varimax rotation yielded a two-factor model, sleep/energy and bother/concern subscales, accounting for 61% of the variance (Table I). Loadings ranged from 0.54 to 0.86. The sleep item loaded onto both subscales, but this was understandable given the hypothesized intermediary role of sleep disturbance between nocturia and QOL. The sleep item loaded better on the sleep/energy subscale (0.64) and was included in that subscale. Higher order factor analyses resulted in a single grouping and confirmed the use of an overall score.

#### RELIABILITY

The alpha-coefficient for the N-QOL overall score and its two subscale scores met the reliability standards (greater than 0.7) for internal consistency. An alpha coefficient of 0.90 was shown for the overall score, and 0.87 and 0.84 for the two subscales, demonstrating high internal consistency. The N-QOL was stable over time, with an intraclass correlation coefficient of 0.82 for the overall score and 0.74 and 0.82 for the sleep/energy and bother/concern subscales, respectively.

#### CONVERGENT VALIDITY

The correlation between the N-QOL scores and sleep quality as measured by the PSQI were sufficient to meet the criteria for convergent validity. The N-QOL overall score correlated with the PSQI

**TABLE II. Correlations of the N-QOL with PSQI, SF-36, and IPSS QOL**

	Sleep/Energy	Bother/Concern	N-QOL Overall Score
<b>PSQI</b>			
Total	0.51*	0.55*	0.58*
Subjective sleep quality	0.58*	0.65*	0.67*
Sleep latency	0.37*	0.37*	0.40*
Sleep duration	0.29*	0.33*	0.34*
Habitual sleep efficacy	0.36*	0.39*	0.41*
Sleep disturbances	0.31*	0.28*	0.32*
Use of sleeping medication	0.11	0.15	0.14
Daytime dysfunction	0.43*	0.33*	0.42*
<b>SF-36</b>			
Social functioning	0.57*	0.35*	0.50*
Energy vitality domain	0.65*	0.31*	0.52*
<b>IPSS QOL</b>			
	0.47*	0.60*	0.59*

KEY: N-QOL = Nocturia Quality of Life Questionnaire; PSQI = Pittsburgh Sleep Quality Index; SF-36 = SF-36 Health Survey; IPSS = International Prostate Symptom Score.  
\* P < 0.01.

**TABLE III. Discriminant validity of N-QOL**

Nocturia	Sleep/Energy	Bother/Concern	N-QOL Overall Score
One time per night (n = 16)	72.40 (18.63)	68.23 (19.18)	70.31 (17.91)
Two times per night (n = 40)	66.98 (22.48)	68.02 (19.82)	67.45 (18.28)
Three or more times per night (n = 51)	58.09 (22.34)	54.50 (24.53)	56.41 (21.69)
P value	0.04	0.01	0.01

Data presented as the mean, with the SD in parentheses.

overall score and subscale scores (Table II), except for the use of sleeping medication score (range 0.32 to 0.67). Correlations with the PSQI (except for the use of sleeping medication) were also found for the sleep/energy and bother/concern subscales (range 0.28 to 0.65).

As predicted, statistically significant correlations were found between the N-QOL overall and subscale scores and the energy/vitality domains of the SF-36 (range 0.31 to 0.65). Similar correlations were observed between the N-QOL and the social functioning domain of the SF-36 (range 0.35 to 0.57). Finally, the N-QOL overall score and subscale scores correlated highly with the IPSS QOL item (range 0.47 to 0.60).

#### DISCRIMINANT VALIDITY

Statistically significant differences were found among the scores of those experiencing one, two, or

three or more episodes of nocturia on both the overall score and the subscale scores (Table III), providing evidence of discriminant validity.

#### COMMENT

The N-QOL is the first questionnaire to assess specifically the impact of nocturia on QOL. It was constructed using a needs-based model to elicit subjective evaluations about the impact of nocturia in the words of the patients. The N-QOL is easily self-administered, taking approximately 5 minutes for the average patient to complete, and can be used in the clinical setting to complement clinical measures such as frequency-volume charts to facilitate treatment decision-making. The questionnaire was developed with input from men experiencing nocturia from different cultures. The psychometric

properties were tested in a similar population in the United Kingdom.

After systematic item reduction analyses, using psychometric criteria discussed a priori by an expert panel, the original questionnaire was reduced substantially from 31 to 13 items. Twelve of the N-QOL items relate directly to nocturia and are used to calculate the score for the N-QOL. The 13 item is a global QOL item, which should be scored separately. This item was included because of its utility in clinical practice as a guide to the patient's general QOL. The remaining 12 items form two subscales—a sleep/energy domain and a bother/concern domain, each containing six items, which can be summed to give an overall score.

The instrument and its subscales had good internal consistency and test-retest reliability. The N-QOL also demonstrated good convergent validity, with the overall and subscale scores correlating highly with sleep quality as measured by the PSQI and energy/vitality and social functioning as measured by the SF-36. The N-QOL did not correlate with the use of sleeping medication subscale, probably because only four participants used sleeping medication on a regular basis. It may also be the case that those with nocturia do not like to use sleeping medication for fear of not waking in time to get to the toilet.

The N-QOL overall score and subscales were also able to discriminate among men experiencing one, two, or three or more episodes of nocturia. It was not possible to assess the responsiveness to change and clinical significance of change scores of the N-QOL, because this was not an intervention study. Evaluating clinical significance can help physicians interpret the benefit to patients of particular reductions in the incidence of nocturia.<sup>17</sup> The ability of the N-QOL overall and subscale scores to discriminate different levels of severity of nocturia suggests that the N-QOL would be responsive to change but this needs to be established within a longitudinal study using an effective intervention.

Finally, future validation of the N-QOL should seek to establish its suitability for use in women with nocturia. Nocturia is a common condition in older women<sup>18</sup> and it is likely that the items of the N-QOL will be equally relevant to women. However, qualitative research with women would need to be conducted to confirm that this is the case.

## CONCLUSIONS

The N-QOL is a valid and reliable patient-based assessment of the impact of nocturia on the QOL of patients. It facilitates understanding of the impact

of nocturia on patients' QOL and can complement clinical measures, aid treatment decision-making, and, potentially, evaluate new treatments for this condition.

**ACKNOWLEDGMENT.** To Jane Goodman, Jan Svihra, and Mauro Niero for their help in developing the N-QOL, and to Janne Thorp, Debbie Marsh, Wendy Robson, and Suzanne Biers for their help in carrying out the methods study.

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**Nocturia Quality of Life Questionnaire (N-QOL)<sup>®</sup>**  
(for men who have to get up at night to urinate)

The following statements are about the impact of 'having to get up at night to urinate'. For each item, please mark an (X) in the box next to the response that best describes how you have felt. Please mark only one box for each statement.

OVER THE PAST 2 WEEKS, HAVING TO GET UP AT NIGHT TO URINATE ...						
1.	Has made it difficult for me to concentrate the next day	<input type="checkbox"/> Every day	<input type="checkbox"/> Most days	<input type="checkbox"/> Some days	<input type="checkbox"/> Rarely	<input type="checkbox"/> Never
2.	Has made me feel generally low in energy the next day	<input type="checkbox"/> Every day	<input type="checkbox"/> Most days	<input type="checkbox"/> Some days	<input type="checkbox"/> Rarely	<input type="checkbox"/> Never
3.	Has required me to nap during the day	<input type="checkbox"/> Every day	<input type="checkbox"/> Most days	<input type="checkbox"/> Some days	<input type="checkbox"/> Rarely	<input type="checkbox"/> Never
4.	Has made me less productive the next day	<input type="checkbox"/> Every day	<input type="checkbox"/> Most days	<input type="checkbox"/> Some days	<input type="checkbox"/> Rarely	<input type="checkbox"/> Never
5.	Has caused me to participate less in activities I enjoy	<input type="checkbox"/> Extremely	<input type="checkbox"/> Quite a bit	<input type="checkbox"/> Moderately	<input type="checkbox"/> A little bit	<input type="checkbox"/> Not at all
6.	Has caused me to be careful about when or how much I drink	<input type="checkbox"/> All the time	<input type="checkbox"/> Most of the time	<input type="checkbox"/> Some of the time	<input type="checkbox"/> Rarely	<input type="checkbox"/> Never
7.	Has made it difficult for me to get enough sleep at night	<input type="checkbox"/> Every night	<input type="checkbox"/> Most nights	<input type="checkbox"/> Some nights	<input type="checkbox"/> Rarely	<input type="checkbox"/> Never
OVER THE PAST 2 WEEKS, I HAVE BEEN.....						
8.	Concerned that I am disturbing others in the house because of having to get up at night to urinate	<input type="checkbox"/> Extremely	<input type="checkbox"/> Quite a bit	<input type="checkbox"/> Moderately	<input type="checkbox"/> A little bit	<input type="checkbox"/> Not at all
9.	Preoccupied about having to get up at night to urinate	<input type="checkbox"/> All the time	<input type="checkbox"/> Most of the time	<input type="checkbox"/> Some of the time	<input type="checkbox"/> Rarely	<input type="checkbox"/> Never
10.	Worried that this condition will get worse in the future	<input type="checkbox"/> Extremely	<input type="checkbox"/> Quite a bit	<input type="checkbox"/> Moderately	<input type="checkbox"/> A little bit	<input type="checkbox"/> Not at all
11.	Worried that there is no effective treatment for this condition (having to get up at night to urinate)	<input type="checkbox"/> Extremely	<input type="checkbox"/> Quite a bit	<input type="checkbox"/> Moderately	<input type="checkbox"/> A little bit	<input type="checkbox"/> Not at all

12. Overall, how bothersome has having to get up at night to urinate been during the past 2 weeks?

- Not at all
- A little bit
- Moderately
- Quite a bit
- Extremely

13. Overall I would rate my quality of life to be...

- Very Good
- Good
- Fair
- Poor
- Very Poor