

Prevalence of Nocturia in a Korean Population Aged 40 to 89 Years

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Aims: The purpose of this study was to evaluate the prevalence of nocturia in Korea, to examine the relationship between nocturia and demographic variables, and to determine the impact of nocturia on daily living. **Methods:** A national telephone survey using quota sampling methods was conducted in Korea. The clinically validated computer-assisted telephone interview approach was used for the survey. **Results:** Of 2005 subjects (1,005 women and 1,000 men) interviewed, 33.5% reported voiding once per night and 48.2% twice or more per night. Nocturia increased with age among both genders and was more common among young women than young men. In all subjects, multivariate analysis indicated that female gender, older age and an overweight condition were independent risk factors. Body mass index was associated with an increased likelihood of nocturia in male but not in female subjects. In female subjects, the likelihood of at least one night-time void was related to delivery number (odds ratio 1.17, 95% confidence interval 1.04–1.32). An impact of nocturia on daily life was reported by 14.6% of subjects and only 3.8% (4.0% of men and 3.7% of women) sought medical care. Commonly reported reasons for not seeking medical care were the belief that nocturia is a normal consequence of aging or is not a disease (92.8% of subjects reporting an impact of nocturia on daily life). **Conclusions:** Although nocturia is highly prevalent in the Korean population, it has only a minor impact on daily living, and few individuals seek medical care. Our study provides a valuable insight into the need for tailored nocturia education addressed to the population who view the condition as trivial. *Neurourol. Urodynam.* 27:60–64, 2008. © 2007 Wiley-Liss, Inc.

Key words: nocturia; quality of life; prevalence; epidemiology; survey

INTRODUCTION

Nocturia is defined as waking at night to void urine.¹ It has been suggested that nocturia is one of the most bothersome symptoms of lower urinary tract symptoms in men and women.² Rising at night to void urine increases the risk of incurring personal injuries, particularly important in elderly subjects, in whom the condition is associated with a greater risk of falls³ and hip fractures.⁴ Nocturia also has other profound implications for sufferers, exerting detrimental effects on quality of life and sleep patterns, and is associated with increased mortality.⁵

However, not all patients with nocturia are bothered by their condition and the degree to which they are bothered is likely to be associated with the degree of nocturia. In addition, several surveys have shown that racial differences exist both in nocturia risk factors and the prevalence of nocturia. These racial differences reflect cultural differences in the perception of nocturia and its importance.^{6–8}

To date, although epidemiologic studies of lower urinary tract symptoms (LUTS) have been performed in many countries, targeted symptoms and populations were generally limited. In addition, the few studies on female nocturia suggest that male and female nocturia may not have identical etiologies.⁹ Furthermore, there is a lack of epidemiological data in a Korean population. The purpose of this study was to evaluate the prevalence of nocturia in an adult Korean national community sample. In addition, the relationship between nocturia and demographic variables including

gender, age and body mass index was examined. Lastly, we determined the impact of nocturia on daily living and willingness to seek medical consultation.

MATERIALS AND METHODS

To assess the prevalence of nocturia, a national telephone survey using quota sampling methods was conducted in 2000. A random sample of adults aged 40–89 years was generated from the target population using a stratified approach based on geographical, gender, and age variables. The study included all territories of South Korea. Within each territory and gender, respondents were stratified into five age groups: 40–49 years, 50–59 years, 60–69 years, 70–79 years and 80–89 years. Prevalence estimates were weighted for the probability of selection on the basis of household size and for the age and sex structure of the resident population of Korea, on the basis of 1995 Census data. Then, telephone numbers were chosen

Rodney Appell led the review process.

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Abbreviations: LUTS, lower urinary tract symptoms; OR, odds ratio; CI, confidence interval; SD, standard deviation; ICS, International Continence Society.

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randomly using a computer program based on the telephone number listings of Korea in 2000. A clinically validated computer-assisted telephone interview approach was used in the survey.^{10–13}

Trained interviewers called households between 18.00 and 22.00 during weekdays and weekends of the study period, to avoid over-representation of housewives. In this survey, 14,559 telephone calls were made and the respondents stratified by their age group. A total of 2,005 adults (1,005 women and 1,000 men) among 14,559 participants 40 years or older completed the telephone interview. The study participants were randomly selected with sampling errors within 2.2%. Interviews generally lasted between 30 and 60 min. An unanswered call was re-attempted at least three times before the telephone number was defined as invalid. Data were collected from only one respondent in each household.

The questionnaire was carefully developed by the authors and evaluated for reliability and validity in advance of the survey, through pilot studies using symptomatic and asymptomatic nonmedical personnel. Data were collected using a structured interview schedule and comprised information on demography and nocturia in the last four weeks. For respondents answering “yes” when asked if they experienced nocturia, a series of additional questions was asked to obtain detailed information on nocturia. Nocturia was identified from the question: “how many times did you most typically get up to urinate from the time you went to bed at night until the time you got up in the morning?” Then, respondents were asked questions about the number of nocturia episodes. Additional questions were asked to determine reasons for waking at night, the impact of nocturia, and willingness to seek medical consultation.

The prevalence of nocturia and its impact were summarized using descriptive statistics. Descriptive statistics were completed using SPSS 11.0 (SPSS, Inc., Chicago, IL, USA) and are reported as percentages. Subjects were stratified by age into five groups: 40–49, 50–59, 60–69, 70–79 and 80–89 years of age. Data for nocturia were extracted and comparisons of the prevalence of nocturia in both sexes in different age decades were analyzed using the Armitage test. To determine the factors that were associated with the number of night-time voids, we estimated odds ratios (ORs) and *P* values for trends using multivariate logistic regression analysis. Subject demographics (gender, age, body mass index) were individually entered into the model. Body mass index was classified as less than or greater than 25.0 kg/m². For women only, delivery number was used as a component of demographics in the multivariate model. The associations between subject demographics and the numbers of night-time voids were determined using maximum likelihood estimates of relative risk with 95% confidence intervals (CIs), on the basis of the logistic regression model. The CIs were predicated from the standard error of measurements of the coefficients and a normal approximation. A 5% level of significance was used throughout, and all statistical tests were two-sided.

RESULTS

The mean and median respondent ages were 59.7 years (standard deviation [SD] 11.5) and 60.0 years for men, respectively, and 59.4 years (SD 11.6) and 59.0 years for women, respectively. The prevalence of nocturia in each age cohort, and the frequency of nocturia, are presented in Figure 1. Of the respondents, 27.3% did not report any nocturia, 33.5% reported voiding once per night and 48.2% twice or more per night (Fig. 1A). Nocturia increased with age among both genders ($P < 0.001$). Nocturia was more common among women than

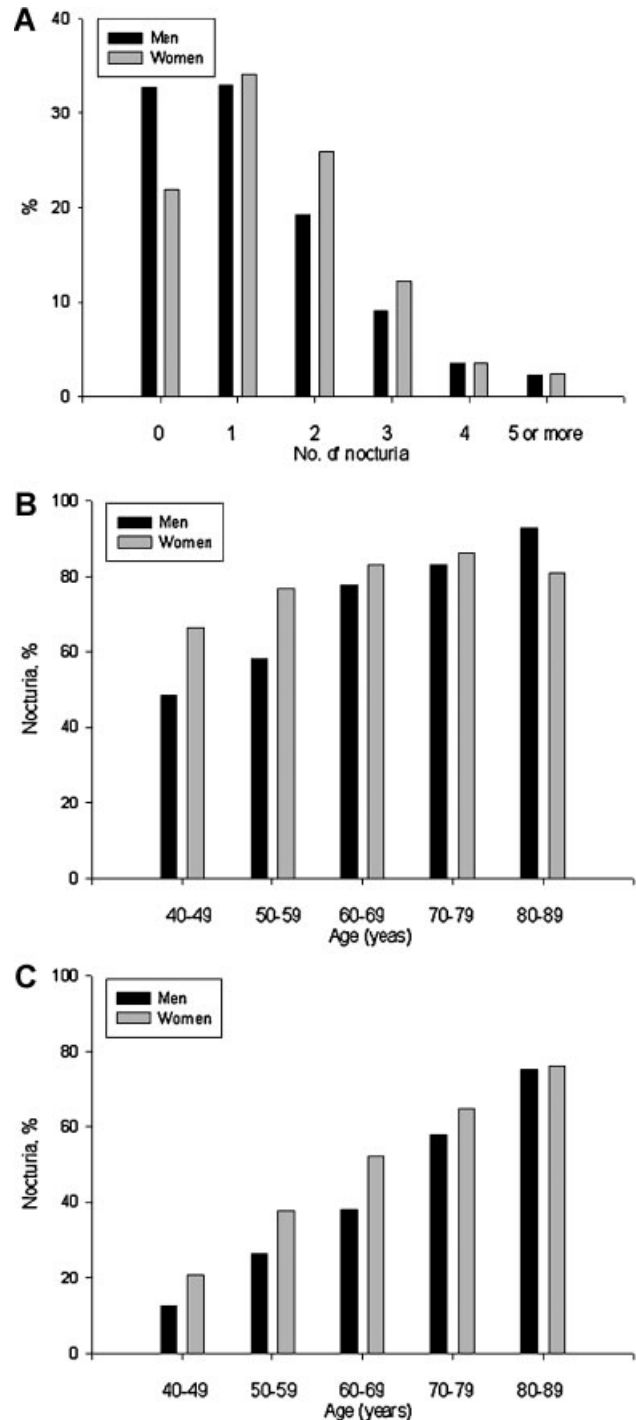


Fig. 1. A. Distribution of severity of nocturia. B. Overall prevalence of nocturia (defined as at least 1 void per night). C. Overall prevalence of nocturia (as at least 2 voids per night).

among men in the two younger age categories ($P < 0.001$ for subjects 40 to 49 years of age and $P < 0.001$ for people 50 to 59 years of age). The prevalence in men began to approach that in women in the age group 60 to 69 years and reached the same prevalence at age 70 to 79 years (Fig. 1B). When nocturia was defined as at least two voids per night, nocturia increased linearly with age among both genders ($P < 0.001$). Nocturia twice per night was more common among young women than

TABLE I. Multivariate Logistic Regression Analysis of the Influence on at Least One or \geq Two Night-Time Voids

	Total		Men		Women	
	Adjusted OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
At least one void/night						
Sex						
Male	1.000					
Female	1.796 (1.457–2.213)	<0.001				
Age (years)						
40–49	1.000		1.000		1.000	
50–59	1.536 (1.181–1.998)	0.001	1.491 (1.044–2.130)	0.028	1.495 (0.990–2.256)	0.056
60–69	3.133 (2.347–4.182)	<0.001	3.829 (2.589–5.663)	<0.001	1.853 (1.149–2.990)	0.011
70–79	4.381 (3.180–6.036)	<0.001	5.285 (3.431–8.139)	<0.001	2.392 (1.371–4.171)	0.002
80–89	5.222 (2.160–12.624)	<0.001	12.536 (2.922–53.784)	<0.001	1.076 (0.316–3.666)	0.907
BMI (kg/m ²)						
<25	1.000		1.000		1.000	
\geq 25	1.506 (1.165–1.947)	0.002	1.503 (1.059–2.132)	0.023	1.463 (0.996–2.150)	0.053
Delivery no.					1.170 (1.038–1.318)	0.010
At least twice/night						
Sex						
Male	1.000					
Female	1.591 (1.307–1.935)	<0.001				
Age (years)						
40–49	1.000		1.000		1.000	
50–59	2.356 (1.738–3.195)	<0.001	2.509 (1.565–4.023)	<0.001	2.337 (1.557–3.507)	<0.001
60–69	4.146 (3.079–5.584)	<0.001	4.430 (2.807–6.991)	<0.001	3.937 (2.624–5.907)	<0.001
70–79	8.343 (6.131–11.353)	<0.001	9.805 (6.161–15.603)	<0.001	7.448 (4.849–11.439)	<0.001
80–89	15.012 (7.406–30.433)	<0.001	19.044 (7.383–49.121)	<0.001	10.741 (3.638–31.716)	<0.001
BMI (kg/m ²)						
<25	1.000		1.000		1.000	
\geq 25	1.391 (1.105–1.750)	0.005	1.495 (1.064–2.099)	0.020	1.334 (0.973–1.828)	0.083
Delivery no.					0.990 (0.965–1.015)	0.431

OR, odds ratio; CI, confidence interval; BMI, body mass index.

among young men ($P=0.012$ for women 40 to 49 years, $P=0.006$ for women 50 to 59 years and $P=0.002$ for women 60 to 69 years). Men reported the same frequency of nocturia as did women when both genders were in their 70 s to 80 s (Fig. 1C).

In all subjects, multivariate analysis indicated that gender, age and body mass index were independent risk factors. In male subjects only, age and body mass index were also associated with an increased likelihood of at least one night-time void. However, in female subjects only, body mass index had no statistical significance. In these subjects, the likelihood of at least one night-time void was related to delivery number (OR 1.17, 95% CI 1.04 to 1.32). When two or more night-time voids was considered to represent nocturia, age only was associated with risk of nocturia in female subjects (Table I).

Nocturia was stated by most respondents as a reason for waking at night, but there were some other reasons for waking, including insomnia. An impact on daily life by nocturia was reported in 14.6% of subjects. When questions regarding medical treatment were asked, only 3.8% (4.0% of men and 3.7% of women) reported that they had sought medical care. More subjects (7.2%) with at least three night-time voids reported that they would seek help from a health professional ($P<0.001$). Commonly reported reasons for not seeking medical care were the belief that nocturia is a normal consequence of aging or is not a disease (92.8%) (Table II).

DISCUSSION

Epidemiologic surveys are important for identifying the characteristics of diseases and their possible causes, and for estimating social impacts of diseases. The estimated prevalence of nocturia has varied, largely due to different definitions of the condition. The standard definition for

nocturia, introduced only recently by the International Continence Society (ICS), is waking at night to void, and applies to any number of voids at any time during a night's sleep; each void is preceded by and followed by sleep and the person is awake before voiding.¹ However, in most earlier studies, nocturia was defined as night-time voiding at least twice per night. Importantly, estimates of the prevalence of nocturia varied depending on the definition of nocturia and age group surveyed. Thus, in the present study, we used this definition (night-time voiding at least twice per night) in the analysis although we also used the ICS definition of nocturia.

In our cohort, the prevalence of nocturia increased with subject age. It has been consistently reported that the incidence of nocturia and the total number of voiding episodes increases with age.^{14–17} Recently, Hakkinen et al.¹⁸ reported that while mild nocturia is common in young, mature Finnish male individuals (37% of 50-year-old men) and increases sharply during the decade from 50 to 60 years (to 60% in the same men at age 60), elderly men experience the greatest increase in severe (three or four episodes nightly) nocturia between ages 70 to 80 years (7% at 70 years; 19% at 80 years). As results of an age-associated diminution of renal concentrating capacity, as well as diminished sodium-conserving ability, loss of the circadian rhythm of antidiuretic hormone secretion, attenuated secretion of renin-angiotensin-aldosterone, and increased secretions of atrial natriuretic hormone, researchers have previously noted an age-associated alteration in the circadian rhythm of water excretion, resulting in increased nighttime urine production in older people.¹⁹ Therefore, age-related physiological changes can alter the regular pattern of urine excretion and lead to an increased nocturnal frequency of voiding. Additionally, aging is associated with anatomical and physiological changes of

TABLE II. Reasons, Impact, and Willingness to Seek Medical Consultation

	No. of night-time voids			P-value*
	One (n = 672)	Two (n = 453)	Three (n = 332)	
Reasons for waking at night				0.345
To void	517 (76.9%)	334 (73.7%)	252 (75.9%)	
Habitually	94 (14.0%)	77 (17.0%)	46 (13.9%)	
Insomnia	60 (8.9%)	37 (8.2%)	29 (8.7%)	
Have worries about wet due to incontinence	1 (0.1%)	5 (1.1%)	5 (1.5%)	
Others	—	—	—	
Impact on daily living				<0.001
None	629 (93.6%)	401 (88.5%)	214 (64.5%)	
Only a little	38 (5.7%)	46 (10.2%)	82 (24.7%)	
Some	4 (0.6%)	—	25 (7.5%)	
A lot	1 (0.1%)	6 (1.3%)	11 (3.3%)	
Seeking medical consultation				<0.001
Have no willingness	647 (96.2%)	421 (92.9%)	278 (83.7%)	
Have willingness	13 (1.9%)	18 (4.0%)	24 (7.2%)	
Already had consulted	12 (1.8%)	14 (3.1%)	30 (9.0%)	

*Armitage test.

Data presented are numbers (%).

the urinary tract, which predispose towards increased urinary frequency without affecting urine volume. The total urine output over 24 h does not change with increasing age but the diurnal rhythm of urine output becomes altered in many elderly patients.^{20,21}

Contrary to our results, nocturia has been reported with similar frequency among men and women in several studies.^{22–25} In a Japanese study, Yoshimura et al.²⁵ did not observe gender differences in nocturia prevalence based on a health screening questionnaire. They reported nocturia (at least two voids per night) in 28.5% of respondents in a study of 4,568 men and 1,949 women. Schatzl et al.²³ reported that 11% of men and 12% of women in a general population from the Vienna area had nocturia, defined as at least two voids per night. Coyne and colleagues reported similar results, with nocturia affecting men and women equally.²⁴ However, Van Dijk et al.²⁶ also observed that in the Dutch adult population nocturia was more common among women than among men, with 9% of men and 16% of women reporting nocturia. Furthermore, in Sweden, Rembratt et al.²⁷ found that men had more nocturia than had women (31% vs. 26%, at least two voids per night) in 2,866 subjects older than 65 years. Bing et al.²⁸ also reported that nocturia was slightly more severe in men than in women, although there was no difference between genders in overall prevalence, in a Danish population of men and women aged 60–80 years. In a study conducted in Finland, nocturia was more common among young women than young men, but the prevalence among men became comparable to that of women as men reached middle age, and exceeded that of women in men aged over 60.²⁹

Similarly, we also found that nocturia was more common among young women than young men, but we found no gender differences in the older population. Mueller et al.³⁰ previously reported urinary habits of asymptomatic adults. Men had higher total fluid intake and mean voided volume than did women. Women voided more frequently than did men and had more voids per liter of fluid intake. Latini et al.³¹ found that urinary frequency was related to fluid intake in asymptomatic men. These data suggested significant gender effects on urinary habits, with females tending to void more often and at lower mean volumes.

In the present study, multivariate analysis indicated that body mass index was an independent risk factor in all

subjects. Those overweight or obese (≥ 25 kg/m²) were at 1.5-fold risk (OR 1.51, 95% CI 1.17 to 1.95) of at least one night-time void and at 1.4-fold risk (OR 1.39, 95% CI 1.11–1.75) of two or more night-time voids, compared with subjects of normal weight. However, while body mass index was associated with an increased likelihood of at least one night-time void in male subjects, it had no statistical significance in female subjects. Prostate size or prostate growth rate has been found to be positively associated with anthropometric measures such as body mass index or waist-to-hip ratio.³² Obesity in adult males may thus be associated with a higher prevalence of nocturia, and an association between nocturia and body mass index might be expected in adult men. However, Asplund and Aberg³³ demonstrated that nocturnal micturition is increased by raised body mass index in women. Furthermore, Tikkinen et al.³⁴ suggested that obesity was associated with increased nocturia more strongly among women than among men. Existing data on nocturia are difficult to interpret, but a number of possible explanations for our results may be proposed. The diverse findings might partly be explained by different research designs and populations. It is also possible that our findings reflect a true difference in the cause of nocturia between countries, because it is currently unknown whether any differences in nocturia etiology exist between countries, races, or social groups. Since the current ICS definition of nocturia does not include causality, future trials should include efforts to identify risk factors for nocturia. Finally, we found that the likelihood of at least one night-time void was related to delivery number in female subjects. To our knowledge, this finding has not been described previously. More studies are needed on the relationship between delivery number and nocturia.

The present study provides some data on reasons for waking at night. It is clear that most (75%) participants with nocturia woke because of an urge to void while 25% woke at night for other reasons. In this study, nocturia of one or two voids/night was not bothersome in approximately 90% of subjects, although the impact on daily living and willingness to seek medical consultation increased with the severity of nocturia. When considering nocturia in relation to other urinary symptoms in men with benign prostatic hyperplasia, Eckhardt et al.³⁵ noted nocturia to be the second most bothersome symptom after urinary urgency. Several community surveys found that two or more voids/night were

"troublesome".^{3,36} While the prevalence of nocturia was slightly higher in the Netherlands than in other countries, Dutch people, however, felt less bothered by having to void at night.²⁶ The distinct Korean cultural background may affect our results, as may concerns with diseases associated with nocturia, or perceptions of aging, because many of our subjects reported that their symptoms were not bothersome enough to seek medical care. However, a lack of awareness or misconceptions about nocturia might also influence our findings because the vast majority of our subjects believed that nocturia was a normal consequence of aging or was not a disease. Bing et al.²⁸ also found that acceptance of the symptom as part of aging might explain why relatively few study participants with nocturia had consulted a physician. Another possibility was a lack of knowledge of treatment opportunities. Similarly, a recent study by Chen et al.³⁷ revealed that in women living in Taiwan, access to medical information was associated with medical consultation, while the lack of knowledge that nocturia was treatable appeared to be an important barrier to medical consultation.

This study is the first to examine the prevalence of nocturia in Korean adults. The study design has limitations, however. First, our study did not use a validated questionnaire because no disease-specific questionnaire has been psychometrically validated in the Korean language. Second, a particular weakness is the low level of interview responses. The statistical consequence of increased sampling error is that it makes it more difficult to define small but real differences as significant. A more serious consequence of non-response is a non-response bias. Non-response bias occurs if the subjects responding to a survey are consistently different from those who do not respond. We suspect that our non-responders were not interested in nocturia and might not be eager to talk about the condition. Unfortunately, the importance of this effect in our survey is unclear because we have no demographic information on the nonrespondents which might allow a comparison with respondents. Finally, in the present study, other factors that can fragment sleep, and that may be associated with nocturia, including thirst, anxiety, worry, obstructive sleep apnea, cardiovascular disease, peripheral edema, leg tingling or muscle cramps were not evaluated.^{28,38,39} Nocturia is not merely a function of aging and generally occurs for a combination of reasons, many of which are amenable to some sort of intervention. Answers to the questions posed above will allow better evaluation of potential therapies and more effective management of this condition.

CONCLUSIONS

The present study has provided insights into the prevalence and details of nocturia in the Korean population. Although nocturia is highly prevalent in Korea, it has only minor impact on daily living, and few individuals seek medical care. Our study provides a valuable insight into the need for tailored nocturia education of this population.

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