Sleep is an essential part of life because it contributes significantly to the restoration and recuperation of physical and mental functioning (Chartier-Kastler & Davidson, 2007). Sleep is defined as a reversible unconscious state with characteristic posture, lack of mobility, closed eyes, and increased arousal threshold (Perlis, Smith, & Pigeon, 2005). Medical and urologic conditions, including overactive bladder (OAB), nocturia, fibromyalgia, chronic pain, and arthritis, can cause nighttime awakenings leading to significant disturbances in sleep (Marin, Cyhan, & Miklos, 2006; Menefee et al., 2000; Schneider & Stanley, 2007).

Disturbed sleep can refer to a broad range of sleep-related problems, including not getting enough sleep or sleep that is of poor quality and non-restorative. Even very brief arousals, if frequent, can decrease sleep’s restorative qualities (Freedman & Roehrs, 2007) due to a lack of deep and rapid eye movement (REM) sleep. Numerous negative effects of poor sleep quality have been documented in the literature.
tecture, including excessive daytime sleepiness, loss of productivity at work, depressive symptoms, increased stress, and a decreased quality of life (Asplund, 2004; Koblet, Borgstrom, & Mattiasson, 2003; Marin et al., 2006; Menefee et al., 2000; Schneider & Stanley, 2007; Stewart et al., 2003). In patients with chronic pain, poor sleep quality has even been shown to lower the pain threshold (Roehrs, Hyde, Blaisdell, Greenwald, & Roth, 2006). This can begin a cycle that results in more severe pain, which in turn results in more nights of poor sleep (Roehrs et al., 2006).

Interstitial cystitis (IC) is a chronic debilitating bladder condition (Dell, 2007; Parsons, Kurth, & Sant, 2007) of unknown etiology and with no known cure. It affects 1.2 million women in the United States. Primary symptoms include urinary frequency, urgency, and pain. The mean age of diagnosis is 40 years. The symptom of nocturia often accompanies daytime urinary frequency, which in turn results in increased stress, and a decreased quality of life (Asplund, 2004; Marin et al., 2006; Schneider & Stanley, 2007; Stewart et al., 2003). Research has yet to evaluate sleep disruption among those with IC. This article presents findings from the first study to examine IC and sleep disruption among middle-aged women.

The primary purpose of this study was to identify the frequency of disrupted sleep among women with previously diagnosed IC. Data were also examined to determine the relationship between poor sleep quality and IC symptoms, including urinary frequency, urgency, nocturia, and pain. The central hypothesis was that overall sleep quality is related to the severity and impact of IC symptoms. The outcome of this study was to provide quantification of sleep difficulties among women with IC.

Using the Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) and O’Leary SantInterstitial Cystitis Symptom and Problem Index (O’Leary, Sant, Fowler, Whitmore, & Spolarich-Kroll, 1997), this study employed a cross-sectional, descriptive, correlational design. Participation in this study was offered to potential subjects online who were also members of a Web-based peer support group for individuals with IC.

Materials and Methods

Institutional Review Board (IRB) approval was obtained from Drexel University. Participants were recruited through the Web site of the Interstitial Cystitis Association (ICA). All subscribers received an electronic mail (e-mail) asking for their participation and giving them a Web page link that connected them to the study questionnaires.

Data collection using rolling admission of a convenience sample occurred from November 23 to December 5, 2008, to achieve a desired sample size of 176 participants. Only participants who met the inclusion criteria by self-report were included in the study analysis. Inclusion criteria included being female and the ability to read English. To ensure the diagnosis of IC, participants also needed to affirm that they had been diagnosed with IC by a potassium sensitivity test or bladder hydro-distension and/or bladder biopsy by a specialist. Finally, participants needed to be between 30 to 60 years of age because the average age of IC diagnosis is 40.1 years (Dell, 2007), and it takes, on average, five to seven years to receive a diagnosis (Dell, 2007). Participants first completed the demographic data form, followed by the O’Leary-Sant IC Symptom and Problem Index and then the PSQI. The entire process took an average of 10 minutes according to a timing mechanism within the online surveying company.

Demographic Form

Data were collected on age, socio-demographic variables, IC history, and menstrual status using an investigator-developed questionnaire. These questions were included based on a review of sleep and IC literature, and were utilized to identify and control for confounding variables of poor sleep quality as well as to ensure subjects/participants met the inclusion criteria. Depressive symptoms were measured using a single question: “Have you felt sad, down, depressed, or blue almost every day of the past month? (This includes having little interest or pleasure in doing things)” (American Psychiatric Association, 2000; Furukawa et al., 1997; Hustey, 2005; Mitchell & Coyne, 2007).

IC Symptom Severity

The O’Leary Sant IC Symptom and Problem Index is designed to measure the severity of symptoms and their impact on individuals diagnosed with IC. The questionnaire is composed of eight questions and two indices. The “symptom index” consists of four questions pertaining to the frequency of pain and urgency. The “problem index” includes four questions regarding the degree to which patients experience each symptom. Summary scores can range from 0 to 36 for both indices combined. Higher scores indicate more severe symptoms. Patients with IC typically score a total of six or more on each index. The test-retest reliability is reported at 0.90 and 0.91, respectively (O’Leary et al., 1997). Both the Problem Index and the Symptom Index strongly discriminate IC patients from controls (O’Leary et al., 1997). The O’Leary Sant IC Symptom and Problem Index has a Cronbach’s alpha of 0.85 for the Symptom Index and 0.90 for the Problem Index (O’Leary et al., 1997).

Sleep Quality

The PSQI is a self-rated assessment of sleep quality and disturbances during the previous
month. There are 19 individual questions that generate seven component scores (0 to 3): subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Global response scores, which may range from 0 to 21, are summed to determine good sleep (0) or worst possible sleep (21). Global scores greater than five are indicative of sleep difficulty (Buysse et al., 1989). A global PSQI score greater than five yielded a diagnostic sensitivity of 89.6% and specificity of 86.5% (kappa = 0.75, p < 0.001) in distinguishing good and poor sleepers (Buysse et al., 1989), and in this study, the Cronbach’s alpha was 0.75.

Results

Four hundred and seven participants completed all items of the PSQI and O’Leary Sant IC Symptom and Problem Index, and were included in this study (see Figure 1 for enrollment summary). The majority of participants were from the United States, were between the ages of 56 to 60 years, and were postmenopausal. They were predominantly Caucasian and had received at least a college education. They had received a diagnosis of IC at least 10 years prior to study participation. Slightly less than half reported that they were experiencing depressive symptoms (see Table 1 for summary of demographics).

Descriptive statistics were used to evaluate the O’Leary Sant results; total symptom scores were high (see Table 2). Urinary frequency led the symptom and impact scores with an overall mean of 8.56 ± 2.3. The mean score of the global PSQI was 13.12 (SD ± 3.61) with all participants reporting a score of six or above. PSQI habitual sleep efficiency (the ratio of time spent asleep [total sleep time] to the amount of time spent in bed) component scores had the highest mean (2.99), median (3) and mode (3) (see Table 3).

A hierarchical multiple re-
regression analysis was conducted to determine the individual predictive contribution of each variable under study. This process allowed the researchers to statistically control for potential confounders of sleep quality, such as depression, menstrual status, and age. Depressive symptoms were initially placed within the regression analysis, followed by menstrual status, then age and years with an IC diagnosis, and finally, the hypothesized predictive variables – urinary urgency, frequency, nocturia, and pain. The results of the multiple regression analysis revealed that depressive symptoms explained 14% ($R^2 = 0.14$, $p < 0.001$) of the variance in global PSQI scores. When menstrual status was entered, an additional 1% of the variance was explained ($R^2 = 0.153$, $p < 0.001$). Age and years with IC were then added. Finally, the four symptom predictor variables were added in a stepwise process. Nocturia contributed 16% ($R^2 = 0.157$, $p < 0.001$) to the variance of sleep quality. When pain was entered, it contributed an additional 4% ($R^2$ change = 0.041, $p < 0.001$), and urinary urgency accounted for 1% ($R^2$ change = 0.013, $p < 0.001$). Frequency was not a significant contributor to the variance of global sleep quality. The complete model explained 40% of the variance in sleep quality. Overall, 21% of the variance in sleep quality was explained by nocturia, pain, and urinary urgency symptoms, after controlling for age menstrual status and age.

Additional multiple regressions were performed on subgroups of the sample. In patients without depressive symptoms ($n = 228$), the total adjusted ($R^2 = 0.31$, $p < 0.001$), indicating the model explained 31% of the variance of sleep quality. After controlling for age, menses, and years with IC, the symptom predictor variables alone explained 29.5% of the variance in sleep quality ($R^2 = 0.295$, $p < 0.001$). In patients with depressive symptoms ($n = 179$), the total model explained 20% of the variance ($R^2 = 0.196$, $p < 0.001$) in sleep quality. Controlling for age, menses, and years with IC, the symptom predictor variables explained 17.1% of the sleep quality variance ($R^2 = 0.171$, $p < 0.001$).

In women who were menstruating ($n = 186$), an $R^2$ of 0.354 ($p < 0.001$) was calculated, indicating a 35% explanation in the variance in sleep quality. After controlling for age, years with IC, and depression, 25.4% of the variance in sleep quality was explained by the symptom predictor variables ($R^2 = 0.254$). The analysis of post-menopausal women ($n = 221$) revealed a 26% explanation ($R^2 = 0.264$, $p < 0.001$) of sleep quality variance; however, after controlling for confounding variables, 14% ($R^2 = 0.14$) of the variance in sleep quality was explained by the symptoms of IC alone. Urinary urgency and nocturia had lower mean values as compared to frequency and pain ($6.91 \pm 2.85$, 7.43 ± 2.58, respectively), but both had modes at the maximum score 11, indicating a ceiling effect.

**Discussion**

This study is the first to document sleep problems and poor subjective sleep quality in women with IC. This finding agrees with earlier findings of poor sleep quality in conditions with symptoms similar to IC as well as in other urologic and chronic medical condition, including chronic obstructive pulmonary disease (COPD), human immunodeficiency virus (HIV), fibromyalgia, and chronic pain disorders where global PSQI scores in these populations have been reported as ranging from 6 to 11 (Dreher, 2003; Marty et al., 2008; Menefee et al., 2000; Reishtein, 2005; Sayar, Arikan, & Yontem, 2002; Theadom, Copley, & Humphrey, 2007). Global PSQI scores were higher in this study’s IC study subjects (mean score 13) than in other

| Table 2. Descriptive Statistics for Variables ($N = 407$) |
|-----------------|---------------|---------------|----------------|-----------------|
|                  | Possible Range | Minimum | Maximum | Mean  | Standard Deviation  |
| Urge total       | 0 to 11        | 2       | 11      | 6.80 | 2.82              |
| Frequency total  | 0 to 11        | 2       | 11      | 8.48 | 2.31              |
| Nocturia total   | 0 to 11        | 2       | 11      | 7.44 | 2.58              |
| Pain total       | 0 to 9         | 1       | 9       | 6.3  | 2.10              |
| Global PSQI      | 0 to 21        | 6       | 21      | 13.12| 3.61              |

<table>
<thead>
<tr>
<th>Table 3. PSQI Component Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Subject sleep quality</td>
</tr>
<tr>
<td>Sleep latency</td>
</tr>
<tr>
<td>Sleep disturbances</td>
</tr>
<tr>
<td>Daytime function</td>
</tr>
<tr>
<td>Habitual sleep efficiency</td>
</tr>
</tbody>
</table>
chronic medical conditions. This indicates that in comparison to individuals with COPD, HIV, fibromyalgia, and chronic pain disorders, women with IC have uniquely poor sleep quality.

Three of the four individual symptoms of IC demonstrated a significant relationship to poor sleep, and 21% of the variance in sleep quality can be explained by the symptoms of IC. The positive linear relationship between severity of IC symptoms and poor sleep indicates that women with IC have a high likelihood of reporting poor sleep related to nocturia, pain, and urgency. Nocturia, followed by pain, was the most significant predictor of poor sleep quality. Interestingly, the symptom with highest reported mean, urinary frequency, was not a significant predictor of sleep quality in this model. Since frequency and nocturia was a significant correlation \( r = 0.61 \), their co-linearity could explain this finding. The PSQI’s component that scored the highest in this population was habitual sleep efficiency. This high score indicates that participants spend large periods of time in bed not asleep and is consistent with insomnia.

Confounding variables that affect sleep were identified in this study population, including depression and menstrual status (Baker & Driver, 2007; Baker, Simpson, & Dawson, 1997; Carney, Edinger, Manber, Garson, & Segal, 2007; Haynes, McQuaid, Ancoli-Israel, & Martin, 2006). The subjects in this study reported a high prevalence of depressive symptoms. In general, most individuals with depression complain of insomnia, specific features of which include difficulty falling asleep, frequent awakenings at night, non-restorative sleep, and decreased total sleep (Baker et al., 1997; Benca, 2005). People with insomnia lie in bed, awake, ruminating on not being able to sleep, which results in poor sleep efficiency (the ratio of time spent asleep [total sleep time] to the amount of time spent in bed) (Perlis et al., 2005). This habit can lead to anxiety regarding sleep, in which the bed becomes associated with being awake instead of being associated with sleeping. Sleep efficiency can be subjectively identified on the PSQI (as it was in this study) or objectively by polysomnogram. In these study subjects, sleep efficiency was the highest component score of the PSQI, demonstrating that women with IC, like people with insomina, spend a great deal of time in bed not sleeping.

In this study, 44% of the participants reported having depressive symptoms. Depression is a common finding in individuals with chronic pain conditions; two out of three patients with chronic pain conditions complain of poor sleep quality or unrefreshing sleep (Call-Schmidt & Richardson, 2005). Chronic pain and sleep disturbances are more prevalent in women than in men and increase with age (Call-Schmidt & Richardson, 2003). Subjective sleep complaints in individuals with chronic pain are similar to those of insomnia and include difficulty falling asleep, early morning awakening, dissatisfaction with sleep quality or quantity, non-restorative sleep, and daytime sleepiness or fatigue. Objective sleep abnormalities documented in patients with chronic pain include increased sleep fragmentation and decreased sleep efficiency (Morphy, Dunn, Lewis, Boardman, & Croft, 2007; Ohayon, 2002). Studies have identified a significant temporal bi-directional relationship and reciprocal interactions between sleep quality and pain severity. For example, while pain can cause poor sleep, poor sleep has been identified to increase pain sensation. Moreover, a night of sleep disturbances can predict next day pain (Affleck, Urrows, Tennen, Higgins, & Abeles, 1996; Castillo, MacKenzie, Wegener & Bosse, 2006; Edwards, Almeida, Klick, Haythornthwaite, & Smith, 2008; Morphy et al., 2007; Raymond, Nielsen, Lavigne, Manzini, & Choiniere, 2001; Roehrs et al., 2006; Smith, Edwards, McCann, & Haythornthwaite, 2007). The literature reports that REM sleep restriction, a result of frequent awakenings, like from nocturia, causes next day hypalgesia (Roehrs et al., 2006).

Nocturia, the symptom with the highest frequency among participants in this study, is another prominent cause of disrupted sleep, no matter what its cause. For example, nocturia, a common symptom in a variety of medical disorders, is relatively common in sleep-disordered breathing, particularly in patients with obstructive sleep apnea (OSA) (Pressman, Figueroa, Kendrick-Mohamed, Greenspon, & Peterson, 1996). In premenopausal women, the incidence of sleep-disordered breathing is quite small (about 1%), but it increases dramatically (to 9%) after menopause (D’Ambrosio, Stachenfeld, Pisani, & Mohsenin, 2005; Pressman et al., 1996). Because nocturia secondary to sleep-disordered breathing is causatively different from nocturia secondary to IC, it requires different diagnostic procedures and treatment (Chasens & Umlauf, 2003; Umlauf et al., 2004). In this study, the majority of participants (54%) were menopausal. Sleep problems, particularly disrupted sleep, are common in women during menopause (Eichling & Sahni, 2005; Moe, 2005). These sleep problems are thought to be associated with hormonal function: the association of hot flashes with a shorter amount of total sleep time and a higher incidence of arousals from sleep has been documented (Freedman & Roehrs, 2007). Hot flashes that occur during sleep have the ability to affect the quality of sleep adversely by bringing women from a deeper, more restful stage of sleep to a lighter, less restful and restorative stage, and even to a full awakening if the hot flash is followed by heavy sweating. Hot flashes before bed may also cause insomnia (Moe, 2004). Insomnia related to the menopause transition has also been attributed to increased depression or anxiety, which may affect the time it takes to fall asleep.
(Moe, 2005). Although menstrual status was controlled for in this study, nonetheless, it is important to note that it can influence the insomnia experienced by these women.

Many similarities between these variables remain to be explored in women with IC. It is clear, however, that for the women who participated in this study, a number of factors may result in poor sleep. Further research aimed at disentangling the exact cause and effect is crucial to the development of interventions for this population.

**Limitations**

The limitations of this study are 1) sample selection bias, 2) use of self-report measures, and 3) response bias. Sample recruitment may have favored a population with more severe IC symptoms, who may be more likely to access the ICA Web site in hopes of finding support, treatment options, and health care providers. Given the number of physician visits it takes to obtain an accurate diagnosis, this study may have missed uninsured or under-insured women with IC. Findings may therefore not be applicable to the entire IC population. Additionally, as an Internet study, participation was limited to women who have access to a computer. Self-report questionnaires, such as those used in this study, require the participant to recall the past month to answer the question. Recall biases may cause answers to be noted as worse or better than the actual experience. Data on subjective symptom severity should ideally be collected at the time they are experienced. Response bias in which respondents answer questions in the way they think the questioner wants them to answer may also have occurred.

**Implications for Practice and Research**

In the authors’ experience, non-physician providers, such as nurses and advanced practice clinicians, follow up on IC symptoms. Because there is no cure for this condition, caring for the patient becomes of paramount importance. Nurses are expert caregivers. Many strategies for symptom relief require behavior management techniques. Nurses excel in patient education and have the time and resources to assist patients in making these lifestyle changes. When patients with IC are treated with pharmacologic agents, the regimen is complex, and improvement is slow at best. Therefore, careful teaching, maintenance, and adjustments are often needed. These tasks are often the responsibility of the advanced practice nurse. Determination of the relationships of sleep and IC symptoms will allow nurses to focus on the most pressing sleep issues. Screening for particular symptoms, such as nocturia and pain, and then managing these symptoms could lead to better sleep quality. Examining the area of largest impairment may help providers target their approach to optimal care of patient symptoms.

The elevation of sleep efficiency scores on the PSQI indicated that women with IC are spending time in bed while not sleeping. Nurses can utilize cognitive behavioral therapy (CBT) for insomnia and educate and teach patients about sleep hygiene to improve sleep quality. One of the first steps of CBT is to drastically limit the amount of time the person spends in bed so that when she does get into bed, she is exhausted and can fall asleep almost immediately. Gradually the time in bed is lengthened, extending the time spent asleep (Perlis et al., 2005). Nurses should be aware that the cause of the poor sleep quality may be multi-factorial. Therefore, appropriate screening of all conditions that may interfere with sleep in this population, such as chronic insomnia, depression, and obstructive sleep apnea, should be performed.

As this study was the first to describe sleep quality in women with IC, many issues remain for future investigation. The predictor variables in this model accounted for a 40% explanation of the variance in subjective sleep quality. To improve the predictability of this model, additional variables should be studied, including lifestyle, hormones, and obstructive sleep apnea. IC predominately affects females. Females are often the caretakers of the family and household; therefore, issues related to work, children, partners, and aging parents, as well as stress and anxiety may be factors in poor sleep quality. Moreover, when women are tired from lack of sleep, they may increase caffeine usage which can lead to worsening sleep problems (Cheek, Shaver, & Lentz, 2004; Hamilton, Catley, & Karlson, 2007; Smith & Zautra, 2008; Smith & Zsohar, 2007); therefore, caffeine use warrants further investigation.

There is a strong association between sleep disturbances and depression (Benca, 2005). Women with IC in the current study may have underestimated or under reported their depressive symptoms. Use of a multi-item tool to measure depression is indicated to more accurately measure this variable. Pain is also a complex issue, and therefore, use of a multi-dimensional tool for pain may be indicated. Clarification regarding specific menstrual status by asking participants to report their last normal menstrual period or by measuring serum LH and FSH levels may also be beneficial. Repeating this study in men would provide an interesting comparison. Additionally, the quantification of anxiety in this population would shed light on the problem. Screening for primary sleep disorders or other medical conditions that may interfere with sleep quality would also provide more thorough explanation of variance in sleep. Using polysomnograms in people with IC would provide objective sleep quality data regarding this topic. All of this information can even-
Conclusions

Women with IC have disrupted sleep and poor subjective sleep quality. Predominant symptoms of IC related to poor sleep include nocturia and pain. Identifying these two symptoms will aid health care providers in screening for symptoms and raise awareness of poor sleep quality in this population of women. The cause of poor sleep quality in this population is multi-factorial; therefore, screening for insomnia, depression, and obstructive sleep apnea should be performed when indicated. Additional research is needed in this area to add to the body of literature and to develop and test interventions for women with IC and poor sleep.

References


Ohayon, M.M. (2002). Epidemiology of insomnia: what we know and what we still need to learn. Sleep Medicine Reviews, 6(2), 97-111.


continued on page 172
Sleep Disruption
continued from page 165


