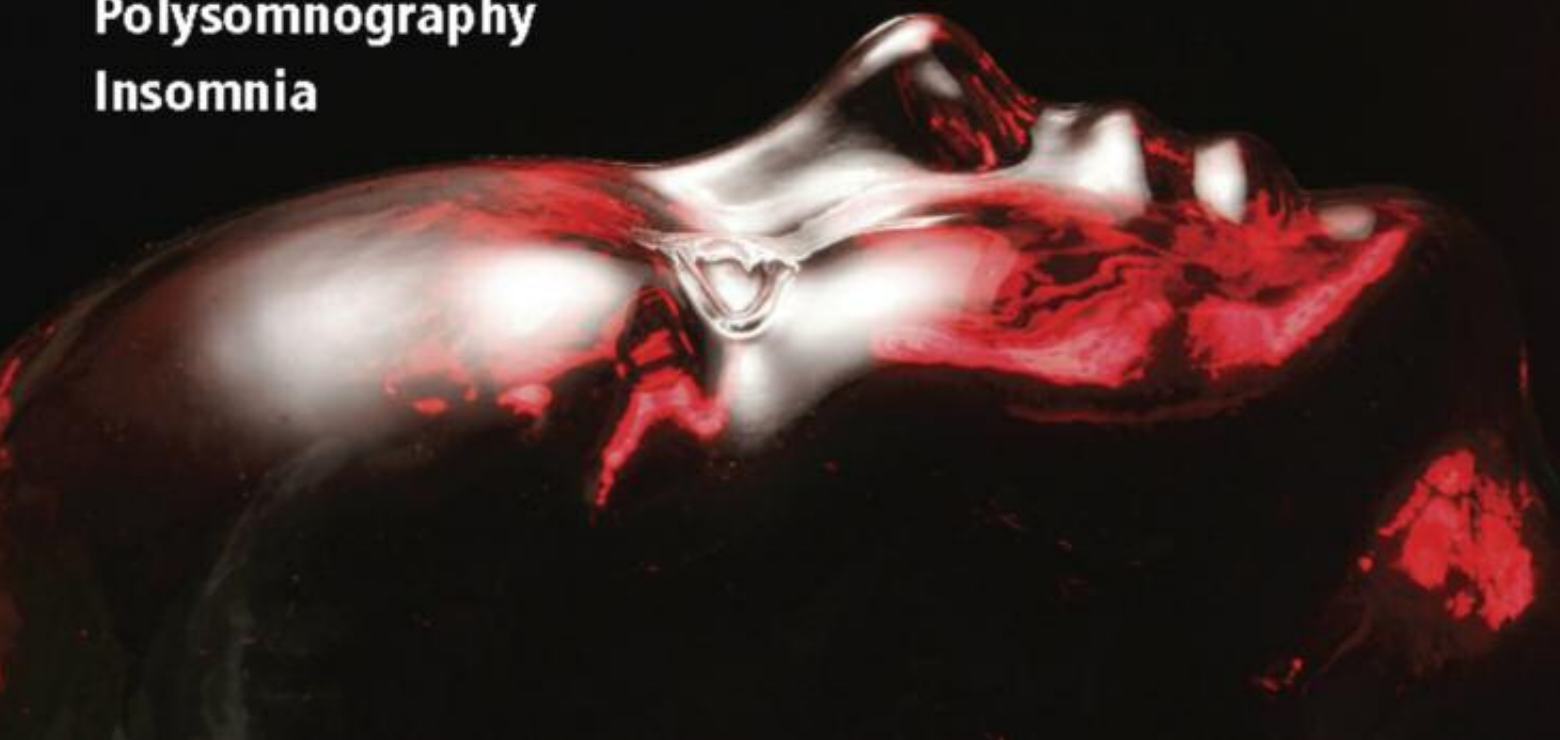


# SLEEP INTERNATIONAL

THE GLOBAL JOURNAL OF SLEEP MEDICINE

**Sleep News**  
**New Products**  
**Polysomnography**  
**Insomnia**



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## Editorial

### What Do You Want?

When we sent out last month's questionnaire for our Sleep Roundtable, we asked our respondents, what are the issues you'd like to see discussed in future roundtables? I thought the replies made for an interesting commentary in themselves.

Actigraph said, "anything to do with reimbursement." Viasys echoed this sentiment: "It would be good to know how the sleep community is interpreting changes in reimbursement, accreditation and diagnostic rules. Additionally, future roundtables could address the way in which sleep medicine may change in response to home sleep monitoring. Do [the changes] mean sleep labs will have fewer patients, or will they have different patients? If they have different patients, how will they need to change to address these patients' needs? Smiths Medical noted they'd like to see comments about the use of end-tidal CO<sub>2</sub> measurement in overnight sleep studies, and Respironics said they'd like to discuss the portable pathway—diagnosis, titration, therapy, and compliance monitoring, as well as the business impact of competitive bidding, and supply replacement stories, plus transportation and occupational health initiatives. Dymedix offered some interesting editorial comments along with its reply: "The PSG industry's reluctance to standardize data transfer files is inhibiting multi-center clinical initiatives," Eric Sivertson of Dymedix noted. "An attempt to establish standardized data transfer files occurred in January '06 through the efforts of New York University Medical Center. A compelling case was presented but I am not sure what the outcome will be. The Europeans are ahead of the US by establishing and implementing EDF and now have a significant advantage over the US in multi-center research capabilities. This should be a wake up call for the US market!" Sivertson added, "We have not seen any new—new technology from this industry for many years. In order for further advancements in sleep medicine science, better and more economical diagnostic technology is needed with more data sharing capabilities. Unfortunately, our ability to develop a sensor technology that goes beyond the existing gold standards is tied to the willingness of the PSG and sensor industries to collaborate towards better solutions. We have not stopped nor will we stop our efforts here because we believe that getting to the next level will require combining diagnostic and sensor technology to help create greater visibility to the physiology of sleep disorders."

Respiratory Therapy will be addressing these concerns in our next roundtable. If you have anything to add to the above, or wish to offer other topics for discussion, please contact me.



Les Plesko, Editor

## News

□ June-July 2008

### DREAM ON

Has September 11, 2001 changed the way we dream? Maybe, according to a study at Tufts University and Newton-Wellesley Hospital in Boston. The study interviewed 44 people (11 men and 33 women) between the ages of 22-70 years, who had been recording their dreams for at least two years. Each of the subjects provided 20 consecutive dreams from their records, with the last 10 recorded before the collapse of the World Trade Center, and the first 10 after. Post 9/11 dreams showed more intense images, but were not longer, more dreamlike or more bizarre. They didn't contain more images of airplanes or tall buildings. In fact, not a single dream involved planes flying into towers, or anything close to that, even though all participants had seen those images many times on TV. While the intensity of the dreams may be from the event, actually life experiences often don't show up in dreams until some time has elapsed. Also, lighter sleep can equal more REM sleep, so perhaps the people weren't sleeping so well. In any event, there's not much of a finding here.

### LET OLD SLEEPING DOGS LIE

The frequency of respiratory disturbances increases dramatically with age, even in healthy individuals without symptoms or signs of obstructive sleep apnea syndrome. An increase in the prevalence of sleep apnea syndrome with age has been well documented. A Brigham & Women's Hospital study focused on breathing irregularities during sleep in 163 healthy people. Irregularities in breathing during sleep were remarkably common, particularly in older individuals. Only around five percent of currently healthy subjects under 50 years of age had a respiratory disturbance index of more than 15 events per hour. But about half of the healthy subjects over 65 years of age had an RDI of more than 15. Respiratory disturbances increase with age even in healthy individuals without symptoms or signs of obstructive sleep apnea syndrome. The researchers surmised that the high degree of respiratory abnormalities were likely the results of aging.

### INSOMNIACS ABANDONED

Patients with insomnia who are diagnosed with accompanying mental health ailments don't get medication to help them sleep, which could worsen their depression or anxiety. Many doctors are reluctant to prescribe sleep aids if patients also have depression, anxiety or mood disorders. An exception is psychiatrists, who were found to be twice as likely as primary



care physicians to prescribe medication for insomnia. The Ohio State University study noted that 20% of Americans have occasional sleep problems, with about one in 10 suffering from chronic insomnia. According to the study, doctors are worried about dependency, but the newest non-benzodiazepines don't carry that risk. Data from the National Ambulatory Medical Care Survey, which tracks Americans' annual outpatient medical visits, identified 5,487 physician visits by patients with insomnia between 1995 and 2004, which was calculated to represent about 161 million US patients. An estimated 6.5 million Americans who saw a doctor for insomnia also were diagnosed with a mental health disorder. Of the visits examined, four of 10 related to mental health, the most common condition being anxiety, followed by mood disorders, high blood pressure, depression, and diabetes. Insomnia patients with mental health disorders were 36% less likely to receive medication for their sleeping problems than were patients without the mental health diagnosis. Those with anxiety were the least likely to receive a sleep aid, with a 45% decreased likelihood of receiving medication, compared to patients without anxiety. Patients visiting psychiatrists had two times higher odds of receiving medication for insomnia than patients visiting family practice or internal medicine physicians.

## CUT IT OUT

Children who suffer from OSA can get dramatic relief from a tonsillectomy and adenoidectomy, according to a study at Saint Louis University. The procedures can take care of sleep problems in 80 to 90% of children. All 79 children in the study showed significant improvement after the surgery, although some children had persistent OSA. The study found that the success of the surgery was directly related to the preoperative severity of OSA, which was defined as less than five incidents of interrupted breathing during the night. The results of surgery were dramatic, even for children who'd had persistent OSA, with incidents dropping from 40 or more to five or less. Other options for persistent OSA are nasal steroids, allergy treatment, additional surgery or CPAP. The study was published in a recent issue of *The Laryngoscope*.

## BLOWING YOUR TOP

Night-time noise from aircraft or traffic can increase a person's blood pressure even if it does not wake them, according to a new study published in the *European Heart Journal*. Scientists from Imperial College London and other European institutions monitored 140 sleeping volunteers in their homes near London Heathrow and three other major European airports. The researchers measured the volunteers' blood pressure remotely at 15-minute intervals and then analyzed how this related to the noise recorded in the volunteers' bedrooms. Blood pressure increased noticeably after the study participants experienced noise louder than 35 decibels, such as an aircraft traveling overhead, traffic, or a partner snoring. This effect could be seen even if the volunteer didn't wake up. Aircraft noise caused an average increase in systolic blood pressure of 6.2 mmHg and an average increase in diastolic blood pressure of 7.4 mmHg. Similar increases in blood pressure were seen for other noise from road traffic. The increase in blood pressure was related to the loudness of the noise. For every 5dB increase in aircraft noise at its loudest point, there was an increase of 0.66 mmHg in systolic blood pressure. People who had been living for at least five years near an international airport, under a flight path, demonstrate a greater risk of developing high blood pressure than a population living in quieter areas, according to related

study in *Environmental Health Perspectives*, which showed that an increase in night-time airplane noise of 10dB increased the risk of high blood pressure by 14%.

## GET TO BED

Ten percent of adults say they don't get enough rest or sleep, according to a CDC study from four states. The percentage of adults who report sleeping six hours or less has increased from 1985 to 2006, with about 60 million people in the US suffering from chronic sleep loss and sleep disorders. The study also found that the prevalence of insufficient sleep decreased with age. An estimated 13% of adults aged 18-34 reported insufficient rest or sleep every day in the past month, compared to only 7.3% of adults ages 55 and older. While some studies have found sleep disturbance more prevalent among older adults, results from this study are consistent with other research that supports the idea that older adults make fewer complaints and adapt their perception of what encompasses sufficient sleep. One out of three adults said they did get enough rest or sleep every day in the past month. The definition of "enough" was subjective and the study was self-reporting.

## CAN'T BREATHE

Children with obstructive sleep apnea have abnormal respiratory-related evoked potentials compared to other children their age. This may explain why these children do not mount protective responses to upper airway collapse, but instead go on to develop OSA, according to a study published in the journal *SLEEP*. The study, at Children's Hospital of Philadelphia at the University of Pennsylvania, focused on nine children with OSAS and 12 normal controls. The innovative technique of respiratory-related evoked potentials was used to test upper airway perception in children with OSA. With this technique, inspiration is blocked for a fraction of a second, and the brainwave response to this occlusion is analyzed. Normal children have certain protective neurologic responses which prevent OSA, the researchers said, while children with OSA have blunted protective responses and have been shown to have abnormal upper airway reflexes during sleep. Children with OSA have also been shown to have a blunted arousal response to respiratory stimuli compared to normal children, despite having normal arousals to non-respiratory stimuli. Furthermore, because children with OSA do not have any breathing problems when they are awake, it is thought that, for OSA to occur, subtle neurologic abnormalities must be present in addition to anatomic abnormalities.

## SHUT UP OR ELSE

Loud snoring with breathing pauses is associated with an increased risk of cardiovascular disease and increased health care utilization, according to a study in *SLEEP*. Researchers at the Institute of Behavioral Sciences at Semmelweis University in Budapest, Hungary, focused on interviews with 12,643 individuals. Loud snorers had 40% greater odds of having hypertension, 34% greater odds of having a heart attack and 67% greater odds of having a stroke, compared with people who do not snore. Quiet snoring was associated only with an increased risk for hypertension in women. Loud snoring was also associated with increased use of healthcare resources like emergency visits and hospitalization. Habitual snoring has been found in about 24% of adult women and 40% of adult men. Both men and women are more likely to snore as they age. Men, however, become less likely to snore after the age of 70. Snoring is more common in people who are overweight. There is a

greater amount of fat in the back of the throat that vibrates as they sleep. Snoring has also been shown to increase during pregnancy. Snoring appears to run in families. Your likelihood of snoring may also increase with drinking alcohol, using muscle relaxers, taking drugs, and smoking.

## GO HOME, IF YOU CAN

A survey by the American College of Chest Physicians Sleep Institute reports that physicians are not getting the sleep they need to function at their best and that work schedules may contribute to their inadequate sleep. The survey found that most physicians sleep fewer hours than needed for peak performance and nearly half of physicians believe their work schedules do not allow for adequate sleep. Results further indicated that, when compared to the general population, physicians reported more caffeine use but better overall health. In a randomized, internet-based questionnaire, the ACCP-SI surveyed 5,000 US physician members about current sleep habits and how sleep affected work and day-to-day performance. Of the 581 respondents, 70% reported needing at least 7 hours of sleep to function at their best during the day, yet physicians reported sleeping an average of 6.5 hours on a workday. Physicians reported “making up” for lost sleep on the weekends or days off by sleeping an average of 7.5 hours a night. Furthermore, 43% indicated that their current work schedule did not allow for adequate sleep. Physicians rarely reported insomnia or difficulty initiating or maintaining sleep. However, 22% reported not feeling refreshed upon waking at least a few nights a week. Most physicians indicated that sleep issues did not significantly impact work performance or other daily activities. However, 18% of physicians reported missing at least one family or leisure activity due to sleep issues. Survey results were compared to the results of the 2008 National Sleep Foundation Sleep in America Poll. Caffeine use was more common among physicians than the general population, with 93% of physicians having at least one caffeinated beverage a day, compared with 81% of the general population. However, the average number of caffeinated beverages consumed, approximately 3 servings daily, was similar between physicians and the general population. Most physicians (83%) reported using caffeine out of habit rather than to keep awake. Physicians also reported being in better overall health than the general population, with 84% percent of physicians stating they were in very good or excellent health compared with 56% in the general population.

## SLEEPY AND NO SEX

Prolonged work days may cause Americans to fall asleep or feel sleepy at work, drive drowsy and lose interest in sex, according to a new Sleep in America poll released by the National Sleep Foundation (NSF). Americans are spending an average of nearly 4.5 hours each week doing additional work from home on top of a 9.5 hour average workday, and 63% state they are very likely to just accept their sleepiness and keep going, while 32% are very likely to use caffeinated beverages when they are sleepy during the day and more than half are at least somewhat likely to use their weekends to try to catch up on sleep. Of those taking their work home with them, 20% say they spend 10 or more additional hours each week and 25% spend at least 7 additional hours each week on job-related duties. Almost one-quarter of all respondents did job-related work in the hour before going to bed at least a few nights each week. The poll found that 29% fell asleep or got very sleepy at work in the month surveyed; 36% nodded off or fell asleep while driving, 32% said they drive up to twice a month while drowsy; 20% have sex less often or don't

care to because they're too sleepy; 14% missed family events, supposedly from being too sleepy, and 12% overslept and were late for work.

## TIME AND TV TIME

Is daylight savings time a shock to the system? Or to the economy? Daylight Saving Time has its roots in the Standard Time Act of 1918; the DST component, which was a wartime energy-saving measure, was repealed after World War I. The current plan was signed into law by Lyndon Johnson in 1966 as the Uniform Time Act. Last year, daylight saving was extended by four weeks. Although the prime-time television schedule is a relic of the technology of radio transmission, it was created when signals could not be broadcast across the country—it remains a powerful cue. People who lived in the Eastern Time Zone and stayed up to till 11:45 to watch Johnny Carson, went to bed earlier when they moved west. A recent study found that while natural daylight patterns have some effect on people's life patterns, the demands of global business—market openings, etc—and regular television schedule, demarcate the boundaries of most Americans' lives. As such, daylight doesn't matter much, researchers claim. People in the professional service sector are more likely to follow the time zone cue, while other services sector (education, health, leisure, and hospitality) are more responsive to television cues. The probability that you are watching TV between 11-11:15 pm decreases with age, but the probability that you are at work between 8 and 8:15 am. increases until retirement age. Marital status and children don't have an effect on TV viewing at 11 pm, but married individuals are less likely to be sleeping at 7 am and more likely to be at work at 8 a.m. Individuals in early television zones (Central and Mountain) are 6.4 percentage points less likely to be watching television between 11 and 11:15 pm than those in later zones, but if the sunset is pushed back by an hour the probability of watching TV at 11pm only increases by about one percentage point.

## PAY ATTENTION

Treatment with methylphenidate appears to have beneficial effects on sleep parameters in adults with ADHD, including increased sleep efficiency and a feeling of improved restorative value of sleep, according to a study by the Central Institute of Mental Health in Mannheim, Germany, which focused on 34 non-medicated patients with ADHD, of whom 24 were without current psychiatric disorders, and 34 control subjects without current psychiatric disorders or psychotropic medication. Compared to the control group, all subjects in the ADHD sample displayed reduced sleep efficiency, with longer sleep onset latency and more nocturnal awakenings. They had altered sleep architecture, with a higher percentage of stage 1 and reduced percentage of REM sleep. Patients also showed a trend toward the reduced total REM density and elevated percentage of wakefulness after sleep onset. The study showed that objective and subjective sleep problems in adults with ADHD are identical with sleep problems in children with ADHD, including longer sleep latencies, more nocturnal activity, reduced sleep efficiency, more nocturnal awakenings and slightly decreased REM activity during sleep, although the clinical significance of the last findings remains to be clarified. The effects of MPH on sleep in adults with ADHD have never been shown before, and the study demonstrated that it has beneficial effects on several sleep parameters in addition to the positive effects on daytime functioning.

## SLEEP PRODUCTS

### NET WORTH

Cardinal Health announced it has signed an exclusive agreement with SleepNet Corporation to be the sole provider of its complete range of products throughout North and South America. SleepNet is a leading provider of gel masks for sleep apnea patients. Under the terms of the three-year agreement, Cardinal Health will assume the responsibility as exclusive distributor for SleepNet's IQ, Phantom, and MiniMe Nasal Masks and the Mojo Full Face Mask in the Americas. Patients may wear a SleepNet Phantom Nasal Mask or IQ Nasal Mask, sometimes referred to as an interface, over the nose during sleep, while pressure from an air blower forces air through the nasal passages. By creating a soft interface between the patient and the mask shell, the discomfort of using a mask is reduced. If the mask is comfortable, the patient is more likely to continue using CPAP and comply with therapy. The Phantom, IQ, Mojo and MiniMe masks are made of a single piece flexible shell, with a soft gel cushion that adapts to facial contours. The IQ and MiniMe also have a pliable ring inside the shell that can be shaped quickly and easily to remove air leaks. There are no tiny pieces that can be misplaced. SleepNet masks are regulated medical devices and are available only with a doctor's prescription. Contact [cardinalhealth.com](http://cardinalhealth.com).

## SLEEP ROUNDTABLE

### Smiths Medical

Information provided by Michael Hubbard, RN, BA, Market Manager- Patient Monitoring & Ventilation, Smiths Medical MDPM.

#### What sleep diagnostic and therapy products do you offer?

Pulse oximeters with Sleep modes for overnight sleep screenings and quantitative capnographs that will interface with laboratory polysomnographs.

#### How are you applying the latest advances in technology to your R&D function?

Researching the latest in digital technology.

#### What training and education do you provide for your staff and/or for users of your products?

We offer employees product training at the beginning of employment. Our outside sales force and distributors provide inservices to end-users. In addition, we have a full-time Clinical Sales Specialist who creates many of our training programs as well as training the trainers.

#### How do your products enhance patient compliance and outcomes?

Products designed for home use are easy to use and require minimal setup.

#### Discuss costs, reimbursement and records management as they impact on the use of your product.

Most testing offered is reimbursable by either Medicare or private insurance.

## Braebon

#### What sleep diagnostics and therapy products do you offer?

Braebon offers a complete line of sensors, a home sleep testing device, portable and stationary PSG diagnostic systems and core management software for the sleep lab. The company began developing and marketing the ULTIMA line of sensors over 10 years ago. Since then we have diversified into sleep diagnostics with the MediByte and MediPalm recorders. These products are leaders in portable recorder technology and are used in a variety of stationary or home sleep testing environments. The product line is completed with Pursuit Outcomes, an industry standard database for sleep medicine. This core management software package will efficiently manage your daily workflow and allow this process to become completely paperless.

#### How are you applying the latest advances in technology to your R&D function?

Our latest device, the MediByte, is the world's smallest sleep apnea and snoring recorder. Using a patent-pending design we were able to get 12 channels into an enclosure that is smaller than a cell phone. The device weighs less than 3 ounces, including battery, so the patient is hardly aware they are even wearing the unit at night. It meets or exceeds all the recently published AASM clinical guidelines for portable monitoring in the diagnosis of OSA. The MediByte also has the ability to record snoring signals and measure the sound levels in a quantitative db channel. This allows you to see just how loud the patient is snoring and the option to play back the snoring so the patient can actually hear it. To reduce the failure rate in home recordings the unit can also be programmed for back to back study nights using the same battery.

#### What training and education do you provide for your staff and/or for users of your products?

In most cases customers have the option of on-site or web based training. We have spent considerable time designing ease of use into all our products making internet training a viable option. Even our sleep diagnostic system only requires 2 cables to hook up so most of our customers go for web based training since it is much less expensive and easier to schedule. We have also found out through experience that breaking the training down into smaller 2 hour sessions works much better. The learning curve tends to be quicker when absorbing new information in smaller pieces. This type of training is very conducive to the internet especially since any number of people can be involved in the sessions and scheduling becomes much easier.

#### How do your products enhance patient's compliance and outcomes?

Our core management software program, Pursuit Outcomes, is an SQL database that tracks patient compliance and outcomes in a number of ways. It can import sleep study results and titration data from a number of PSG systems. In addition we are now interfacing Outcomes to a number of compliance tracking software programs so you will be able to generate a series of reports that monitor and trend this data from a single patient or your entire patient population. We have also developed a new report that will follow the patients first 12 weeks of CPAP use specific to the new Medicare NCD guidelines. Other reports can also be generated that track a variety of patient and facility



# Innovation from Compumedics



## Home Sleep Testing, Portable, Ambulatory, Wireless, Type III.....

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Best of all, each product interfaces with our renowned **ProFusion PSG3** software suite which offers integrated support for the latest AASM scoring recommendations. Compumedics cross-product integration allows for faster adaptation and minimal disruption of your workflow. With **ProFusion PSG3** you can extend your services and enhance patient care while meeting the latest compliance and accreditation standards.

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parameters providing detailed information that will assist the sleep center with better patient care.

**Discuss costs, reimbursement and records management as they impact on the use of your product.**

Since all the products at Breabon are designed and manufactured under the same roof, we have the ability to control costs better and pass those savings on to the customer. We are constantly improving the quality of every product so the customer continues to get good value with everything we offer. Three significant events that are changing the field of sleep medicine are home testing, lab accreditation and documented patient compliance. Reimbursement for home testing is now just around the corner from both public and private payers. This will be another source of revenue for sleep labs that figure out it is much more of an advantage than threat. The demand for lab accreditation and good records management is also being driven from the reimbursement side since better testing and treatment programs will provide better patient outcomes.

## Actigraph

**What sleep diagnostic and therapy products do you offer?**

The ActiGraph is a small ambulatory monitoring device used to measure sleep efficiency based on calculations through a validated algorithm collected by an accelerometer. The device may be used as a screening tool for a diagnosis that has yet to be determined or as a post-therapy tool to measure the efficacy of a particular treatment regimen. In both scenarios, the monitoring may take place within the comfort of one's own bed.

**How are you applying the latest advances in technology to your R&D function?**

We are currently adding extra software enhancements that will allow the clinician greater ease and understanding of the data as well as an opportunity to do remote monitoring through wireless technologies.

**What training and education do you provide for your staff and/or for users of your products?**

We have customer support staff available during standard business hours five to seven days a week either by phone or the internet. On-site training is also available where applicable.

**How do your products enhance patient compliance and outcomes?**

By the ability to screen a potential sleep disorder as well as the ability to follow up a course of therapy from one's own bed.

**Discuss costs, reimbursement and records management as they impact on the use of your product.**

ActiGraph is actively working to seek the designation of a Class I CPT Code. Once a code is established, various restrictions, private plans and pull-through barriers at the regional CMS level, will also have to be addressed before consistent reimbursement will be unilateral.

## Respironics

Interview with Gretchen Jerzerc, Director, US Marketing, Sleep Disordered Breathing, Respironics, Inc.

**What sleep diagnostic and therapy products do you offer?**

Respironics offers a complete range of sleep diagnostic and therapy products and services, supporting sleep labs and homecare providers in treating patients across the entire care pathway—identification, diagnosis, titration, treatment, adherence management, and re-supply. Respironics' Alice systems, supported by industry-leading after-sales support and service, enable sleep labs to effectively diagnose patients with obstructive sleep apnea (OSA) and other sleep disorders.

Respironics has developed a suite of products for both portable testing in the home and in the sleep lab. Respironics' Stardust II Sleep Recorder fulfills the requirements of Level III and Level IV diagnostic devices. A key dissatisfier for sleep technicians is the need to awaken a patient during titration to move him or her from one bed/titration unit to another due to the need for a different treatment mode. Respironics has launched the OmniLab titration system, which incorporates all key Respironics therapy modalities including BiPAP autoSV, streamlining the work of sleep technicians and avoiding the need to switch patients from one titration system to another during the night. Respironics supports DMEs and sleep labs with Sleep Therapy products to meet their varying needs and those of the patients they serve, working toward our common goal of comfortable patients who are adherent to their PAP therapy over the long term. Respironics has developed Flex Family of Pressure Relief Technologies, EncoreAnywhere Patient Management System, and advanced Auto and BiPAP autoSV algorithms to support DMEs and sleep clinicians with right-first-time therapies for patient success. Finding the right mask for the patient is critical to therapy success. Respironics offers good-fitting gel technology in the ComfortGel mask and the minimally-invasive OptiLife nasal pillows mask as part of a full range of nasal, pillows, and full-face masks. As a further support to therapy success, Respironics offers a 30-day Satisfaction Promise Program to help get patients fitted with the mask that will work best for them.

**How are you applying the latest advances in technology to your R&D function?**

Respironics' vision is to anticipate market needs to be the leading worldwide provider of solutions to the sleep and respiratory markets. To this end, we are constantly working to develop and leverage new technology and update our product and service portfolio. In addition to internal development efforts, we also partner with outside technology experts in areas including sensors, capnography, and oximetry.

**What training and education do you provide for your staff and/or for users of your products?**

At Respironics, we believe education and training are critical for our employees as well as for DMEs and clinicians to be able to provide optimal therapy support to patients. Respironics demonstrates a significant commitment to education and training by offering CEU and CME workshops and online monographs, interface selection and fit workshops, and an active Speakers Bureau. We support local A.W.A.K.E. groups, including an annual tour of our manufacturing facility in



Murrysville, PA. We encourage homecare providers, clinicians, and patients to visit our Web site, [sleepapnea.com](http://sleepapnea.com), where we continue to add helpful content. Respironics and ResMed, two leaders in the sleep industry, partner to support "Sleep Well, Be Healthy," a communications and public relations initiative to raise public awareness of sleep apnea and support OSA identification and screening.

### **How do your products enhance patient compliance and outcomes?**

Successful therapy is a huge priority for Respironics. I would say it's our Holy Grail. That is why we have put such a strong focus on our Flex comfort technologies, which provide real, perceivable pressure relief at exhalation, making it easier for patients to stick with their PAP therapy. Research has shown patients to sleep an hour and 42 minutes longer on C-Flex vs. on straight CPAP. Since introducing C-Flex, Respironics has developed Bi-Flex and A-Flex, available in our BiPAP and Auto technologies, respectively. Demos of these comfort technologies can be arranged by any Respironics field representative. Respironics is so convinced about the benefits of Flex technologies that we offer a Flex Promise Program. Respironics field representatives can provide details. Another key to compliance and successful therapy outcomes is compliance monitoring. Respironics has launched EncoreAnywhere in select markets, a Web-based system that enables DMEs, sleep clinicians, and other physicians to all access patient therapy data, optimizing their management and support of the patient's care. EncoreAnywhere is also a great productivity enhancer for DMEs and clinicians, as it enables modifications to therapy settings over the Internet via wired modem.

### **Discuss costs, reimbursement and records management as they impact on the use of your product.**

Respironics places great value on understanding the challenges facing our customers and users, and works to provide tools and solutions. We are keenly aware of the downward trends in reimbursement and the cost constraints of managed care models, and continue to develop value segment product offerings to help customers handle these challenges. Two recently launched examples include the SleepEasy Sleep Therapy System, a simple, reliable CPAP with integrated humidifier, and the ComfortFusion nasal mask with replaceable cushion. Respironics crafts product configurations such as DuoPacks (masks packaged with two cushions) to support DMEs in their supply replacement initiatives. In fact, we have developed an entire suite of products, marketing materials, and analytical tools to support DMEs and full-service sleep labs in starting or growing successful supply replacement programs. Through the SupplyDirectSM program, Respironics is able to drop ship replacement masks, tubing, and other accessories directly to patients' homes on behalf of the DME. The EncoreAnywhere technology mentioned above is also a valuable tool for patient record management.

## **Dymedix**

Information provided by Eric Sivertson, CEO and President.

### **What products do you offer for diagnostics?**

The technology within Dymedix sensors is the first new concept in the sleep sensor market in the last 20 years. It is based on the

science of Piezo and Pyro electric principles that were first discovered by the Currie Brothers over 100 years ago. However it wasn't until 1969 that Dr Kuwai determined that processed polyvinylidene fluoride (PVDF) produced voltage in direct proportion to temperature change, pressure, noise and movement. PVDF is now used in many sophisticated applications such as rate responsive pacemakers, ultrasound, seismic accelerometers and advanced naval sonar to name a few. In 1998, our founder and Chairman, Peter Stasz, invented a sleep sensor using PVDF to accurately measure airflow, snore and movement. Our PVDF sensors were introduced to the market in 2001 and we now have a formidable customer base and are developing new applications for the sleep market.

### **How are you applying the latest advances in technology to your R&D function?**

Our engineers employ the latest version of LabVIEW from National Instruments. This extraordinary tool allows virtual creation and testing of new products and enhancements to existing products. With more than 20 projects currently in the works, Dymedix is consistently striving to fulfill its mission to enhance the science of sleep medicine.

### **What training and education do you provide for your staff and/or for users of your products?**

For our customers we provide 24/7 technical support via our toll-free tech line. In addition, we will provide an in-service on premises anytime it is needed. Staff training is ongoing in each field of expertise. From the person who answers the phone to the CEO we believe education is essential to growth not only for the individual employee but the company as a whole with an eye toward providing the best possible service to our customers.

### **How do your products enhance patient compliance and outcomes?**

First, the signal from our sensor can be filtered through our electronic filter module to produce the most clinically appropriate waveform so the patient is accurately diagnosed to receive the proper therapy prescription. Secondly, we have a complete line of disposable pediatric, infant and neonatal sensors that provide a very accurate signal to meet the diagnostic needs of this demanding patient population. This is also the fastest growing segment within sleep. We believe we offer the best technology for this segment of the market.

### **Discuss costs, reimbursement and records management as they impact on the use of your product.**

Given the relatively new discipline of sleep medicine, reimbursement criteria vary from state to state and payer to payer. We now have sensors that will produce the appropriate clinical waveforms to ensure reimbursement without jeopardizing accurate diagnosis. We have a full line of both reusable and disposable sensors that utilize PVDF technology. The Independent labs and regional-national sleep lab chains need economical and durable supplies to meet their operating objectives while still providing high quality outcomes. Our reusable product line meets these needs. The hospital-owned and -affiliated segments are coming into the line of sight of Infection Control and JCAHO, and are moving to the safety and convenience of disposable supplies. We meet these needs also.

# Cardinal Health

## What sleep diagnostic and therapy products do you offer?

Cardinal Health offers a range of sleep diagnostic products including: SomnoStar Software, our new SomnoStar z4 PSG amplifier and also the new SomnoStar Orbit portable sleep monitoring system as well as the QDC demodulator for our RespiTrace respiratory movement sensors. Our sleep therapy products include the new SNAPP 2.0 direct nasal interface, The Advantage Series nasal and full face masks as well as a complete line of headgear, chin straps, CPAP tubing and filters. We are also exclusively distributing, in the Americas, the SleepNet line of gel masks that provide a high quality and very comfortable line of masks.

## How are you applying the latest advances in technology to your R&D function?

While medical devices require a conservative approach to engineering we do pursue the latest technologies that can be safely applied to patient care. Our new SomnoStar z4 amplifier has advanced video technology and Bluetooth® capabilities that provide future expansion opportunities. Our QDC continues to offer sophisticated respiratory monitoring that is now part of the new AASM scoring guidelines. Our patient interfaces are evolving based on the latest modeling technologies that are used to design interfaces so that they will fit the widest range of faces. While this is not something that will be seen by either the patient or the clinician it will impact their use of the mask and the comfort of its fit.

## What training and education do you provide for your staff and/or for users of your products?

We offer two primary modes of training for our sleep diagnostics systems: onsite at the sleep lab or at our Yorba Linda, CA campus. Users are given a choice when training is ordered. We offer CME credits to all attending. Our trainers are all experienced registered sleep technologists that not only know the system that they're training on, but also the setting in which it will be used and the situations that are likely to arise during use. Additionally, once back at home in their sleep lab they can call in to our technical support staff, also experienced registered sleep technologists for support. We offer unique VCare technology that allows our support staff to connect directly to your SomnoStar system and walk you through an area that you may be having difficulty with or assume control and fix a problem remotely. Our sleep therapy group is providing a one hour CEU class on mask fitting that provides AARC credit.

## How do your products enhance patient compliance and outcomes?

Our SomnoStar PSG system, when coupled with our QDC RespiTrace technology, provides calibrated respiratory movement information which can be viewed in a flow volume loop format. This approach to analysis affords the clinician a powerful perspective on respiratory effort in OSA and this enhances the therapeutic titration process. Optimal titration helps to assure that the patient is not over or under treated and this can lead to improved acceptance of therapy and in turn improved compliance. Additionally the SomnoStar system has an integrated relational database that allows our users to build reports that manage patient care and office efficiencies. Our sleep therapy products are all designed with patient comfort

and compliance in mind. Our SNAPP 2.0 is both comfortable and flexible as it avoids contact with the bridge of the nose. Our Advantage Series masks have features such as the triple layer seal and the flex bubble to maintain a seal with as little force as possible. The line of SleepNet masks use "softer than human tissue" gel to provide a secure seal and flexible shells to help conform to a range of facial shapes. These high quality masks are all developed with the assumption that comfort equals compliance.

## Discuss costs, reimbursement and records management as they impact on the use of your product.

The recent changes to the National Coverage Determination (NCD) issued by CMS allow for the diagnosis of obstructive sleep apnea with the use of an unattended home sleep monitor. This is causing an increasing number of sleep laboratories and others to look at this technology as an alternative to in-lab PSG. There remains a fair amount of uncertainty around the eventual coverage of CPAP and home sleep testing, but it is clear that we'll have to find ways to more cost effectively manage the obstructive sleep apnea disorder process. Additionally, there is an increasing drive to assess outcomes, particularly in light of the CMS NCD and its 12 week initial coverage for CPAP. The industry is being challenged to find ways to ensure compliance and to document it in a cost effective manner. Comfortable CPAP therapy technology that helps to promote compliance will become increasingly important.

# Compumedics USA

Information provided by Tom Lorick, Compumedics USA.

## What sleep diagnostic and therapy products do you offer?

Compumedics offers a comprehensive range of diagnostic products for Sleep, covering every application and setting. Our fixed bed products for the traditional sleep lab features the E-Series as well as our ambulatory products, the Siesta, Safiro and Somté PSG. All these systems are capable of full AASM compliant PSG studies. For Ambulatory or home studies we offer the Siesta, Safiro, Somté, and Somté PSG to provide Type II and III solutions for all situations. Somté PSG and Siesta really offer flexibility and cost effectiveness as they both double for full PSG or ambulatory/HST testing, expanding the utility of these systems in and out of the lab.

## How are you applying the latest advances in technology to your R&D function?

Compumedics has been an early adopter of wireless technologies, and robust RIP solutions. We offer both WiFi 802.11 (Siesta) and Bluetooth (Somté PSG) technology solutions for practically any environment imaginable. We have practical experience with both technologies and are positioned to demonstrate the advantages each has, rather than focusing narrowly on one solution for all situations. Our Summit IP has offered a universal RIP solution for some time now with Abdominal, Thoracic and SUM channels compatible with most systems on the market today. Our enterprise level lab management software, neXus, first released in 2003, set the bar for advanced patient and study data management supporting multiple sites, advanced data archiving, HL7 data transfers with EMR systems, managed secure remote access and full database support. In the past year we released our fifth generation

ProFusion PSG3 software which allowed us to meet the new AASM Scoring manual requirements by the day they were published.

### **What training and education do you provide for your staff and/or for users of your products?**

Compumedics is proud to offer a variety of custom and classroom-based education alternatives. Options from basic sleep fundamentals posted on our website to full class room based didactic and practical courses in our new corporate training facility in Charlotte, NC to on-site individualized course at the customer facility are available. We pride ourselves in providing a curriculum approved by the AAST allowing us to offer CEC credits for students fulfilling all the stringent qualifications as required by the AAST in order to earn credits for their experience with Compumedics. We understand and appreciate that our systems are most effective when the technologist and staff are fully trained and knowledgeable in use.

### **How do your products enhance patient compliance and outcomes?**

By offering solutions from HST to advanced research applications Compumedics is diligent in providing the tools the user needs to be effective the first time, without repeating studies or requiring customization or work-arounds. This enhances productivity in the lab, and since we provide the flexibility of wireless ambulatory and HST systems that all work with our existing software suite, the patient can be tested in the most comfortable environment for them, which again increases patient compliance and efficiency for the lab.

### **Discuss costs, reimbursement and records management as they impact on the use of your product.**

With the relatively low reimbursement for home sleep testing, as reported by our customers, managing costs and improving efficiency are more important than ever for a lab to be successful. By extending our software suite, and NeXus Lab Management System to our ambulatory and HST systems our existing customers are up and running with expanded clinical service very quickly, minimizing start-up time and cost. Our NeXus LMS takes the time consuming tasks of data management, including archiving, EMR integration and report management etc and consolidates and automates the activities to reduce paperwork and redundant non-productive tasks within the lab. As reimbursement changes, the old adage "time is money" is more applicable than ever, and Compumedics is focused on streamlining our customers operations to cut out unnecessary non-productive activities.

## **CleveMed**

Information provided by Hani Kayyali, President, CleveMed.

### **What sleep diagnostic and therapy products do you offer?**

CleveMed currently offers a wide range of wireless diagnostic sleep systems for attended, remotely attended and unattended sleep studies. Because of their wireless and compact designs, all CleveMed systems can easily expand a sleep company's services to include not just in-lab sleep studies, but also studies in nontraditional settings such as patient homes, hospital patient rooms, nursing homes, and others. The 22-channel Sapphire PSG offers expanded PSG for in-lab testing, while the 14-

channel Crystal Monitor PSG Series offers Standard PSG ideal for Type II home monitoring allowing sleep staging. The 9-channel SleepScout is the smallest of all three and is a Type III home monitor with extended capabilities such as ECG and leg EMG assessments. We also have new and exciting projects in the pipeline under development.

### **How are you applying the latest advances in technology to your R&D function?**

CleveMed is developing several innovative technologies to advance sleep testing and treatment. We have incorporated state of the art wireless capabilities in all of our products to permit longer range and reliable data transmission. We are the only company that offers multiple wireless protocols designed to best meet the various radio-frequency environments. I believe, we are the only company that incorporates a miniaturized removable SD memory card in all of our products providing many advantages for home monitoring such as extended recording time (at least 5 sleep studies), fast data download, shorter device turn around time. Our devices are all small and battery-powered including the in-lab versions making them very portable and therefore highly desirable for the new applications. We are finalizing a new product called PSG@Home system, which will allow studies to be conducted in the patient's home with real-time remote monitoring including video. As mentioned before, CleveMed is also working on a number of innovative technologies in the areas of patient follow-up, data analysis and others.

### **What training and education do you provide for your staff and/or for users of your products?**

All customers of CleveMed's sleep systems receive a detailed User's Guide and free online collaborative training via WebEx, covering patient hook-up, collecting studies, importing study files, scoring and reporting. Dependent upon the quantity purchased, free on-site training is also available. For our portable sleep system, SleepScout, patient self-hookup diagrams and videos are also provided. We are very proud of our staff. They include highly qualified registered sleep technologists, QA, product and sales managers who are very responsive to customers' needs and play an active role in product development.

### **How do your products enhance patient compliance and outcomes?**

All of our sleep systems are wireless and compact, making them ideal for use in any setting, including the patient home. Testing patients in the comfort of their own home is ideal for those who may have difficulty coming to the sleep lab, such as the elderly, those suffering from chronic pain or patients who do not like "medical facilities". Therefore, home sleep testing can speed diagnosis and treatment but the benefits from our products do not stop here. Our products are also ideal for patient follow-up and CPAP management, which I think is the most important driving force behind the future of sleep medicine. Our SleepScout or Crystal 20 products allow easy hookup, can interface to any CPAP machine, and can generate objective evaluation of RDI or AHI, which are needed to establish improvement from baseline or to identify comorbidities such as complex sleep apnea. This type of follow-up evaluation is critical for proper home auto-titrations, documentation for CPAP reimbursement at the 12 week post CPAP initiation, and most importantly for healthier patient outcome.



**Discuss costs, reimbursement and records management as they impact on the use of your product.**

Regarding reimbursement, the two main factors include the new AASM guidelines and the recent CMS portable monitoring ruling. Our expanded PSG system, Sapphire PSG, meets the requirements set by the new AASM guidelines. SleepScout, a Type III device meets both the AASM portable monitoring guidelines and the recent CMS requirements for portable monitoring reimbursement. With respect to records management, all of our systems include a removable SD memory card for both data back-up purposes, as well as easy and efficient records management. The future of CPAP reimbursement will likely add new restrictions (that should not surprise anyone), but I believe, the most important restriction, which may happen sooner than later, will be objective and quantifiable documentation of CPAP efficacy like improvement in RDI, AHI, Central events, etc. Today, CMS is not too restrictive on the type of "OSA improvement" documentation, but the trend has started. Successful providers will be those that take the chance now to lay the infrastructure for a cost efficient but comprehensive disease management program or risk reimbursement denials. CleveMed's products will help providers lead the way in sleep monitoring for today and tomorrow.



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# Insecure Attachment is Associated with the $\alpha$ -EEG Anomaly During Sleep

Eileen P. Sloan, Robert G. Maunder, Jonathan J. Hunter, Harvey Moldofsky

## Abstract

**Background:** The  $\alpha$ -EEG anomaly during sleep, originally associated with chronic pain, is noted in several psychiatric and medical conditions and is also present in some normal subjects. The exact significance of the  $\alpha$ -EEG anomaly is uncertain, but it has been suggested to be a nonspecific response to a variety of noxious stimuli. We propose that attachment insecurity, which is often associated with a state of hypervigilance during wakefulness, may be associated with the  $\alpha$ -EEG anomaly during sleep.

**Methods:** Thirty one consecutive patients referred to a Sleep Disorders Clinic for clinical assessment of sleep complaints underwent standard polysomnographic recording. The degree of alpha activity in polysomnographs was scored visually according to standard criteria. Attachment insecurity was measured with the Experience in Close Relationships—Revised questionnaire.

**Results:** Attachment anxiety was significantly associated with the proportion of sleep in which  $\alpha$  waves were present ( $df = 1$ ,  $F = 5.01$ ,  $p = 0.03$ ). The relationship between the  $\alpha$ -EEG anomaly and attachment anxiety was not explained by the distribution of sleep and mood diagnoses, medications, anxiety symptoms or depression symptoms.

**Conclusion:** Interpersonal style in close relationships may be related to sleep physiology. Further research to determine the nature of the relationship between attachment, sleep and other factors that are related to each of these, such as a history of personal adversity, is warranted.

## Background

Alpha EEG activity, a sinusoidal rhythm with a frequency of 8-12 Hz, is the predominant EEG frequency recorded during passive wakefulness. It is recorded most prominently over the occipital and parietal regions of the scalp and is attenuated by eye opening and noise. During the onset to sleep, alpha EEG activity typically diminishes and is replaced by a low voltage activity of mixed frequency, mainly theta (4-7 Hz) and, as sleep deepens, delta (0.5-3 Hz) activity. The persistence of alpha activity during sleep (the  $\alpha$ -EEG anomaly or alpha-delta anomaly) and its superimposition on delta waves, was initially described in patients with psychiatric illness and subsequently in patients with fibromyalgia. Many subsequent reports have found a similar association of the  $\alpha$ -EEG anomaly with fibromyalgia and with chronic “non-organic pain.” The study of the  $\alpha$ -EEG anomaly in the sleep of patients with chronic pain suggests that the anomaly represents an “intrusion” into normal sleep, i.e. that the anomaly acts as an indicator of a more vigilant state during sleep with resulting daytime symptoms of non-restorative sleep.

The  $\alpha$ -EEG anomaly is not always associated with pain, and painful conditions are not always associated with the anomaly. Rains and Penzien, examining the sleep records of over 1000 patients referred to a sleep disorders clinic, reported that the  $\alpha$ -EEG anomaly occurred at a similar rate in patients with chronic pain, other medical/sleep disorders, and in psychiatric patients and that 60% of patients with the anomaly did not report pain. The authors concluded that the  $\alpha$ -EEG anomaly may reflect a non-specific response to a variety of noxious stimuli. Why some patients would show such a response to noxious stimuli when it is absent in others exposed to the same stimuli is unclear, but we postulate that psychological factors could play a role.

A body of recent research demonstrates that adult attachment style is associated with many aspects of health, health behaviour and disease. We have described a model of several causal pathways by which attachment insecurity may contribute to physical illness. The intensity and duration of behavioural and physiological responses to stress, for example, may be moderated by attachment style. Attachment insecurity may also be associated with lower levels of vagal tone, which has implications for rapid recovery from periods of stress or arousal. Furthermore, insecure attachment may increase

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Sloan, Maunder and Hunter are with the Integrated Medicine Project, Department of Psychiatry, Mount Sinai Hospital, Toronto; Sloan and Moldofsky are with the Centre for Sleep and Chronobiology; Sloan, Maunder, Hunter and Moldofsky are with the University of Toronto, Canada. Reprinted from BioMed Central, BioPsychoSocial Medicine, © 2007 Sloan et al; licensee BioMed Central Ltd. This is an Open Access article distributed under the terms of the Creative Commons Attribution License. For full references, please go to the BioMed Central website and type in the full title of the article.

**Table 1: Comparison of groups defined by degree of alpha EEG intrusion into sleep<sup>1</sup>**

	Percentage of sleep study with $\alpha$ -EEG activity		
	0 – 40% (n = 9)	40 – 60% (n = 14)	60 – 100% (n = 8)
Age (mean $\pm$ SD)	36.8 $\pm$ 11.9	43.8 $\pm$ 8.6	45.4 $\pm$ 9.0
Female gender	6 (66.6%)	12 (85.7%)	8 (100%)
<b>Clinical Diagnoses<sup>2</sup></b>			
Psychophysiological insomnia	1 (11.1%)	0 (0.0%)	0 (0.0%)
Non-organic insomnia	2 (22.2%)	3 (21.4%)	2 (25.0%)
Idiopathic hypersomnia	2 (22.2%)	0 (0.0%)	0 (0.0%)
Obstructive sleep apnea	2 (22.2%)	0 (0.0%)	1 (12.5%)
Periodic limb movement			
Disorder/Restless legs syndrome	2 (22.2%)	5 (35.7%)	3 (37.5%)
Insomnia due to a mental disorder	2 (22.2%)	7 (50.0%)	4 (50.0%)
Fibromyalgia	1 (11.1%)	3 (21.4%)	2 (25.0%)
<b>Medication</b>			
No medication	6 (66.6%)	9 (64.3%)	4 (50.0%)
Antidepressant	1 (11.1%)	2 (14.3%)	2 (22.2%)
Benzodiazepine	0 (0.0%)	1 (7.1%)	0 (0.0%)
Opiate	1 (11.1%)	2 (14.3%)	0 (0.0%)
Other medication	2 (22.2%)	2 (28.6%)	2 (25.0%)

<sup>1</sup>All between-group differences are non-significant by ANOVA (age) or Kruskal Wallis test (categorical variables).

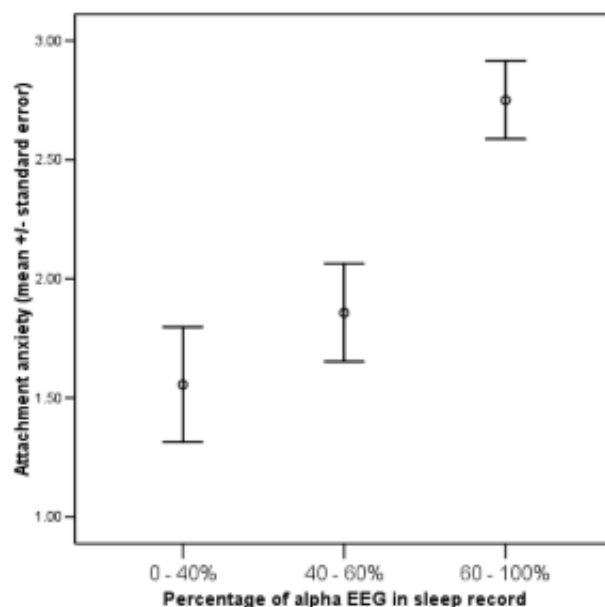
<sup>2</sup>Co-morbidities result in total percentages > 100%.

perceived stress and make it difficult for the individual to use proximity to trusted others to buffer stress or recover from stressful events.

Attachment was first described by Bowlby as an interactional system that allows a child to maintain protective proximity to a care giving adult through the developmental period in which the child cannot care for him or herself. Attachment plays an important role in stress regulation in the early years of life by facilitating perceived and actual security through a system of cues and responses that enable the infant to respond to perceived dangers and undesirable isolation with responses that increase proximity to its mother or primary caregiver. Individual attachment styles are recognizable clusters of trait-like interpersonal characteristics, designated in childhood by the categories secure, anxious, ambivalent and avoidant, including tendencies toward greater or lesser expression of distress, and greater or lesser preference for contact and proximity. Childhood attachment style is associated with affect regulation and, specifically, the capacity to be soothed and to feel subjectively secure. Longitudinal studies demonstrate the stability of attachment style from childhood to early adulthood, and over decades in adulthood, but also the conditions under which attachment style may change with experience.

Self-report measures of adult attachment style measure dimensions of attachment anxiety and attachment avoidance. According to Bartholomew's influential model of adult attachment, secure attachment is recognized as the combination of relatively low attachment anxiety and low attachment avoidance. Depending on the instruments used, about 50-60% of adults have a secure attachment style, which can be characterized as a flexible balance between preferences for autonomy and intimacy. Therefore, insecure attachment in its various types (indicated by high attachment anxiety, high attachment avoidance, or both) is common.

Individuals who are high in attachment anxiety are described as hypervigilant with regard to both the perception of possible threats and the availability and responsiveness of others. Since insecure attachment is thought to be characterized by stress susceptibility and hyperarousal, it is plausible that the  $\alpha$ -EEG anomaly during sleep is a marker of the unusual arousal associated with attachment insecurity expressed as a heightened responsiveness to a variety of noxious stimuli. In particular, if the  $\alpha$ -EEG anomaly is associated with insecure attachment, then it would not be confined to patients with



**Figure 1**  
Magnitude of difference in attachment anxiety between groups low, medium and high in  $\alpha$ -EEG anomaly during sleep.



chronic pain or with any particular medical or psychiatric diagnosis. We hypothesized that the  $\alpha$ -EEG anomaly would be found more often in people with higher levels of attachment insecurity and tested this hypothesis in a clinical sample of patients referred to a sleep clinic for sleep studies.

## Methods

This study was performed in a Sleep Disorders Clinic staffed by psychiatrists, respirologists and neurologists. Patients are referred to the clinic for a variety of clinical complaints, including snoring, insomnia, and excessive daytime sleepiness, typically by their primary care physician. Consecutive patients were approached to participate in the study. All subjects approached agreed to participate and provided informed consent. This study was approved by the Research Ethics Board at Mount Sinai Hospital, Toronto.

Subjects underwent a standard clinical polysomnographic (PSG) recording: surface electrodes were applied to the scalp at locations C3, C4 and Oz referred to A1 and A2, according to the International 10-20 system of electrode placement, using a low impedance paste. Electrodes were also applied to the submentalis muscle to record the electromyogram; bilaterally on the anterior tibialis muscle to record leg movements, bilaterally on the outer canthus to record the electro-oculogram; and in the second intercostal space at the midline bilaterally to record a two lead electrocardiogram. Respiratory effort was recorded by inductance plethysmography via belts placed on the chest and abdomen. Arterial oxygen saturation was recorded with continuous recordings with a pulse oximeter, which uses a probe attached to the index finger. Airflow was measured via flow sensitive nasal prongs. A sleep diagnoses was made by a sleep specialist (board certified) or a sleep physician following assessment of the PSG and clinical assessment of the patient.

Recordings were carried out on the Sandman 6.1 PSG system or the CompuMedics Profusion PSG system 2.02. All subjects provided a minimum of 6 hours of data. The PSG was scored and staged visually by a trained technologist, blind to the patient's attachment style, according to standard criteria. The technologist had been trained in the visual assessment and rating of  $\alpha$ -EEG activity in the PSG. She had been part of a previous study on inter-rater reliability for the visual scoring of the  $\alpha$ -EEG anomaly. The findings demonstrated a favourable inter-rater reliability. Alpha activity was defined as lying within the range of 7-12 Hz, with a minimum peak to peak amplitude of 5  $\mu$ V. It was rated according to the percentage of alpha events per epoch of stage 2 non-rapid eye movement sleep and slow-wave sleep. Arousal events and artifacts were eliminated from the analysis. After scoring each epoch, average percentage-of-alpha rating values were obtained for stage 2 non-REM sleep and SWS across the recording. There was no differentiation between tonic and phasic alpha activity. Rather than rating alpha activity as a continuous variable, we employed the method used in our clinical setting, i.e. the percentage of alpha activity noted in the overall recording in 5 groups: 0-20%, 20-40%, 40-60%, 60-80%, 80-100%. Due to small numbers of subjects at the extremes of this range (0-20%,  $n = 2$ ; 80-100%,  $n = 2$ ), these groups were collapsed into three groups for this analysis: 0-40%, 40-60%, 60-100%.

Attachment was measured with the Experience of Close Relationships—Revised (ECR-R) questionnaire. The ECR-R is a

36-item self-report questionnaire that surveys attitudes towards close relationships with intimate partners. Each statement is scored on a 7-point scale ranging from strongly disagree through neither agree nor disagree to strongly agree. The ECR-R has been derived through the application of item-response theory to choose the 36 best items from a pool of 323 attachment items drawn from the available and commonly used attachment instruments, all completed by 1,086 undergraduate students and its reliability and validity are established. Symptoms of anxiety and depression were measured with the Symptom Check List (SCL)-90-R.

In order to test the hypothesis that attachment insecurity is associated with the  $\alpha$ -EEG anomaly, the relationship between ECR-R scores and  $\alpha$ -EEG class was tested by univariate analysis of variance (ANOVA). The relationship between anxiety and depression subscales of the SCL-90-R and  $\alpha$ -EEG class was also tested by ANOVA. Since neither anxiety nor depression symptoms differed by  $\alpha$ -EEG class these variables were removed from the reported results to maximize degrees of freedom. Because attachment anxiety and attachment avoidance were significantly inter-correlated ( $R = 0.45$ ,  $p = 0.01$ ) the relationship of these variables to  $\alpha$ -EEG class was tested in separate ANOVA.

## Results

Thirty-one sleep clinic patients participated in the study. Twenty five (80.6%) were female. Subjects ranged in age from 25 to 60 (mean 41.6, standard deviation 9.5). The distribution of subjects by percentage of the sleep study occupied by alpha activity was: 0 to 40% alpha – 9 subjects (29.0%), 41 to 60% alpha – 14 subjects (45.2%); 61 to 100% alpha – 8 subjects (25.8%). Clinical diagnoses, along with the medications patients were taking at the time of the study (Table 1) were similar in the three alpha groups. Subjects with clinical diagnoses of fibromyalgia ( $n = 6$ ) or mood disorder ( $n = 13$ ) did not differ from the remaining subjects with respect to  $\alpha$ -EEG rating (Chi-square = 2.14,  $p = 0.44$ ), mean attachment anxiety ( $p = 0.60$ ) or attachment avoidance ( $p = 0.80$ ). There were no significant differences between the  $\alpha$ -EEG groups in depressive ( $df = 1$ ,  $F = 0.04$ ,  $p = 0.84$ ) or anxiety symptoms ( $df = 1$ ,  $F = 1.17$ ,  $p = 0.29$ ) as rated by the respective sub-scales of the SCL-90-R. Attachment anxiety was not significantly correlated with symptoms of anxiety ( $R = 0.19$ ,  $p = .38$ ) or depression ( $R = 0.04$ ,  $p = 0.84$ ). Neither was attachment avoidance significantly related to symptoms of anxiety ( $R = 0.01$ ,  $p = 0.95$ ) or depression ( $R = 0.27$ ,  $p = 0.22$ ).

Attachment anxiety was significantly associated with  $\alpha$ -EEG class ( $df = 1$ ,  $F = 5.01$ ,  $p = 0.03$ ). If age is added to this analysis, it is not associated with  $\alpha$ -EEG ( $df = 1$ ,  $F = 1.33$ ,  $p = 0.26$ ), and the contribution of attachment anxiety to  $\alpha$ -EEG remains significant ( $df = 1$ ,  $F = 4.19$ ,  $p = 0.05$ ). If anxiety symptoms are included in this analysis, they are not associated with  $\alpha$ -EEG class ( $df = 1$ ,  $F = 0.88$ ,  $p = 0.36$ ), but the contribution of attachment anxiety to  $\alpha$ -EEG class is somewhat reduced ( $df = 1$ ,  $F = 3.64$ ,  $p = 0.07$ ). Attachment avoidance was not significantly associated with  $\alpha$ -EEG class ( $df = 1$ ,  $F = 2.73$ ,  $p = 0.11$ ).

In order to determine if the between-group differences in attachment anxiety were clinically meaningful, mean attachment anxiety score was calculated in each of the three  $\alpha$ -EEG class groups. Compared to subjects with 0 to 60% alpha, in subjects with 61 to 100% alpha, attachment anxiety is greater by > 1 point on the 7-point scale of the ECR-R (Figure 1).

## Discussion

This examination of the relationship between attachment style and the degree of  $\alpha$ -EEG sleep in a clinical population suggests that attachment insecurity, in particular insecurity expressed as anxiety about intimate relationships, is associated with a biological measure of sleep disturbance. The finding is not due to a higher degree of anxiety or depressive symptoms in anxiously attached individuals, which makes it unlikely that attachment anxiety is a proxy for generalized anxiety or depression. The link that is found between attachment insecurity and the  $\alpha$ -EEG anomaly during sleep is consistent with the thesis that the anomaly is a marker of hyperarousal or hypervigilance which increases individual sensitivity to noxious stimuli during sleep.

The magnitude of the difference in attachment scores between  $\alpha$ -EEG groups (Figure 1) is likely to be clinically meaningful. For example, we have previously measured ECR-R attachment anxiety scores (which range from 1 to 7) in hospital healthcare workers (a non-clinical sample): mean  $2.48 \pm \text{S.D. } 1.28$ , healthy primary care patients:  $2.42 \pm 1.38$ , outpatients with ulcerative colitis:  $2.46 \pm 1.34$ , outpatients with heart failure:  $2.49 \pm 1.42$ , and emergency department patients:  $3.29 \pm 1.18$ . The level of attachment anxiety in sleep clinic patients, at  $3.82 \pm 1.13$ , appears to be higher than is found in non-acutely ill people and the difference between groups ( $> 1$  ECR-R point) is a difference of about 0.75 standard deviations.

It is plausible that people who are high in attachment anxiety, likely as a result of earlier adverse experiences, and who are characterized during wakefulness as hypervigilant, anxious, and difficult to soothe, do not down-regulate this arousal state completely when they fall asleep. Conceptually, attachment anxiety is related to expectations of abandonment. It can be speculated that this expectation may be particularly salient, developmentally and in the context of the evolutionary purpose of the attachment system, when an individual must fall asleep and trust that their environment will remain secure and that their caregivers will remain present while they are unconscious. The usual mechanisms for ensuring proximity to the attachment figure, such as watching, crying, following, and clinging, are not available during sleep. The inevitable loss of control over care-seeking behaviors which occurs in sleep may lead individuals who are high in attachment anxiety to experience heightened arousal during sleep.

The lack of association between attachment avoidance and the  $\alpha$ -EEG anomaly may be because attachment avoidance is not linked to hypervigilance during sleep or may be due to a lack of statistical power to detect a relationship in this small sample. The latter explanation is supported by the direction of the trend towards a relationship between these variables. To illustrate this trend, attachment avoidance was higher in subjects with 60–100%  $\alpha$ -EEG ( $4.49 \pm 1.17$ ) than in subjects with  $< 60\%$   $\alpha$ -EEG ( $3.19 \pm 1.08$ ,  $p = 0.02$ ).

This study is limited by its small sample size and the use of a clinical convenience sample with mixed sleep diagnoses. The clinic in which the study took place is unique in that its multidisciplinary staff (psychiatry, respirology, neurology) attracts a more diverse range of clinical problems than are found in many sleep clinics (particularly, fewer patients with obstructive sleep apnea). This is not a major limitation, however, because the anomaly is not confined to any particular

sleep diagnosis. We were unable to control what medications patients were taking at the time of their sleep study, including medications which affect sleep architecture. However, the range of medications was similar across the three groups and most patients (61%) were not taking any medication. In the clinical setting, only one polysomnograph was performed and patients did not typically undergo an adaptation night. As a result, we are not able to comment on the night to night stability of the  $\alpha$ -EEG anomaly. Since many EEG phenomena are sensitive to the first night effect, further studies should incorporate at least two consecutive nights of polysomnograph recording. Finally, while we are confident in our technique of scoring the  $\alpha$ -EEG anomaly, the use of quantitative EEG analysis would permit more precise analyses. Thus, we present findings that require replication in studies which address these limitations.

Further research on non-clinical subjects is required to determine if insecure attachment is associated with the  $\alpha$ -EEG anomaly in the absence of sleep complaints. A larger study could test the prediction that  $\alpha$ -EEG is most elevated in persons with the fearful attachment style (both high attachment anxiety and high attachment avoidance) as would be expected if  $\alpha$ -EEG is determined in part by early adversity. It would be intriguing to explore the relationship between attachment insecurity and impaired sleep quality (chronic insomnia or non-restorative sleep). Further research might also include study of the recently identified association between the cyclic alternating pattern (CAP) in patients with fibromyalgia and poorer quality of sleep. CAP is a measure of sleep microstructure, which corresponds to a prolonged oscillation of the arousal level between two reciprocal functional states, phase A (greater arousal) and phase B (lesser arousal). The pattern represents a condition of instability of the level of vigilance that manifests the brain's fatigue in preserving and regulating the macrostructure of sleep. A higher CAP rate is associated with a greater degree of physical impairment in fibromyalgia. It would be interesting to look beyond the  $\alpha$ -EEG anomaly and examine the association between sleep microstructure and attachment style.

## Conclusion

We present the first evidence that a pattern in close interpersonal relationships, particularly anxious insecurity about intimate relationships, is associated with a biological measure of sleep disturbance, the  $\alpha$ -EEG anomaly, an anomaly which is associated with significant health problems.

# Perception Versus Polysomnographic Assessment of Sleep in CFS and Non-Fatigued Control Subjects: Results From a Population-Based Study

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## Abstract

**Background:** Complaints of unrefreshing sleep are a prominent component of chronic fatigue syndrome (CFS); yet, polysomnographic studies have not consistently documented sleep abnormalities in CFS patients. We conducted this study to determine whether alterations in objective sleep characteristics are associated with subjective measures of poor sleep quality in persons with CFS.

**Methods:** We examined the relationship between perceived sleep quality and polysomnographic measures of nighttime and daytime sleep in 35 people with CFS and 40 non-fatigued control subjects, identified from the general population of Wichita, Kansas and defined by empiric criteria. Perceived sleep quality and daytime sleepiness were assessed using clinical sleep questionnaires. Objective sleep characteristics were assessed by nocturnal polysomnography and daytime multiple sleep latency testing.

**Results:** Participants with CFS reported unrefreshing sleep and problems sleeping during the preceding month significantly more often than did non-fatigued controls. Participants with CFS also rated their quality of sleep during the overnight sleep study as significantly worse than did control subjects. Control subjects reported significantly longer sleep onset latency than latency to fall asleep as measured by PSG and MSLT. There were no significant differences in sleep pathology or architecture between subjects with CFS and control subjects.

**Conclusion:** People with CFS reported sleep problems significantly more often than control subjects. Yet, when measured these parameters and sleep architecture did not differ

between the two subject groups. A unique finding requiring further study is that control, but not CFS subjects, significantly over reported sleep latency suggesting CFS subjects may have an increased appreciation of sleep behaviour that may contribute to their perception of sleep problems.

## Background

Chronic fatigue syndrome (CFS) is a complex illness defined by unexplained persistent or relapsing fatigue for  $\geq 6$  months that is not attributable to exertion and is not improved by rest. The fatigue must be accompanied by at least 4 of 8 defining symptoms (significant worsening of fatigue following exertion, unrefreshing sleep, impaired memory or concentration, muscle pain, joint pain, headache, tender cervical or axillary nodes, and sore throat) and the illness must cause substantial functional impairment.<sup>1</sup> Nearly all individuals with CFS report unrefreshing sleep at the time of diagnosis<sup>2-6</sup> and self-reported sleep problems distinguish CFS cases from matched non-fatigued control subjects.<sup>7</sup> In addition, complaints of non-refreshing sleep and difficulty getting to sleep or staying asleep remain common (decreasing from 95.4% to 79.2% and 81.4% to 75%, respectively, when CFS subjects are studied at 3 yearly time points after diagnosis.<sup>8</sup> These complaints and their duration satisfy the definition for chronic insomnia as defined in an NIH Consensus Science Statement.<sup>9</sup> However, while sleep complaints are a prominent component of CFS, major primary sleep disorders (narcolepsy and sleep apnea) are exclusionary medical conditions that preclude the research case definition of CFS.<sup>1,10</sup>

Further, polysomnographic studies have not consistently documented sleep abnormalities in people with CFS.<sup>11,12</sup> These observations raise the possibility that people with CFS perceive the quality of their sleep differently from well individuals; i.e., the prominence of self-reported sleep difficulties in CFS may reflect a heightened awareness of altered sleep physiology. Altered self-perception (sensitivity to internal signals) has been suggested to play a role in CFS,<sup>13</sup> but few studies have explored the relationship between self-reported sleep quality and objective polysomnographic sleep parameters in persons with CFS. Fossey et al., 2004, contrasted sleep parameters obtained by polysomnography and sleep diaries, medical diagnoses, and results of structured interview and self-report measures between clinic-based subjects with CFS or narcolepsy, and

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**Table 1: Sleep disorders in CFS and non-fatigued controls**

<i>Sleep Disorders</i> <sup>†</sup>	<b>CFS (35)</b>	<b>NF (40)</b>	<b>p*</b>
<i>Obstructive Sleep Apnea (borderline)</i>	3 (8%)	3 (7%)	/
<i>Periodic Limb Movements</i>	7 (20%)	8 (20%)	NS
<i>Insufficient Sleep Syndrome</i>	1 (2%)	0	NS
<i>Delayed Sleep Phase Syndrome</i>	0	1 (2%)	NS
<i>MSLT Normal</i>	16 (45%)	16 (40%)	/
<i>MSLT Borderline</i>	13 (37%)	15 (37%)	NS
<i>MSLT Pathological</i>	6 (17%)	9 (22%)	NS
<i>Any Sleep Study Alteration</i>	26 (48%)	28 (52%)	NS

\* Chi-square test.

NF = Non-fatigued; MSLT = Multiple Sleep Latency Test.

† No cases of Bruxism, Central Sleep Apnea or Upper Airway Resistance Syndrome were identified.

those with no medical or psychiatric diagnoses. Their analyses, which included CFS subjects with sleep disorders identified by PSG and presence of insomnia, described the typical symptom and impairment profiles of the syndrome in CFS patients.<sup>14</sup> A study of twins discordant for CFS found that those with CFS were significantly more likely to report insomnia and daytime sleepiness than their healthy siblings yet night time polysomnographic measurements and multiple sleep latency test (MSLT) did not differ between the groups. This led the authors to speculate that twins with CFS suffered from sleep-state misperception insomnia according to the 1990 International Classification of Sleep Disorders.<sup>14-16</sup> The term sleep-state misperception insomnia has been replaced by the term paradoxical insomnia, which describes paradoxical relationships between objective and subjective sleep assessments in such patients according to the 2005 coding manual.<sup>17,18</sup>

**Table 2: Sleep architecture in CFS and non-fatigued controls – Night 2 adjusted for medication use**

	<b>CFS n = 35</b>	<b>NF n = 40</b>	<b>p-value**</b>
	Adjusted Mean*	Adjusted Mean*	
Total sleep time (min)	400.3	407.9	0.52
Sleep period time (min)	453.8	457.8	0.79
Latency to sleep onset (min)	21.3	17.1	0.47
REM latency (min)	98.4	106.8	0.40
Sleep efficiency (%)	88.3	90.2	0.32
Wake after onset (min)	53.8	44.0	0.69
Wake % Sleep Period	11.7	9.8	0.72
# Arousals	105.7	110.2	0.81
Arousal index	15.9	16.3	0.82
Stage 1 (% TST)	9.6	9.5	0.79
Stage 2 (% TST)	48.2	50.8	0.28
Stage 3/4 (% TST)	19.9	17.4	0.20
REM (% TST)	22.3	23.3	0.98
Alpha intrusion	0.29	0.49	0.11

\*Mean values adjusted for medication use (yes/no).

\*\* p-values generated using 2-factor analysis of variance

In the present study, we evaluated the relationship between subjective and objective measures of sleep alterations in persons with CFS and non-fatigued controls. As detailed previously,<sup>12</sup> we conducted overnight polysomnographic studies and daytime multiple sleep latency evaluation of 43 individuals with CFS and 43 non-fatigued controls. The study also included measures of participants' long term and short-term subjective reports of sleep quality. The following questions were addressed: 1) Are subjective sleep problems characteristic of CFS? 2) Is there objective evidence of abnormalities of sleep in CFS as defined by polysomnography? And, 3) Are there associations between subjective sleep problems and objective sleep abnormalities in persons with CFS? To avoid referral bias, a major limitation of studies that recruit CFS subjects from specialty clinics, we enrolled persons with CFS and non-fatigued controls identified from the general population of Wichita, Kansas.<sup>19,20</sup> We also employed standardized criteria to define CFS and controlled for the use of medications known to affect sleep.

## Methods

**Participants:** This study adhered to U.S. Department of Health and Human Services human experimentation guidelines and received Institutional Review Board approval from the CDC and collaborating institutions. All participants gave informed consent.

Between January and July 2003, we conducted a 2-day in-hospital study of adults identified with CFS from the general population of Wichita.<sup>19</sup> The in-hospital study enrolled people who participated in the 1997 through 2000 Wichita Population-Based CFS Surveillance Study.<sup>20</sup> The primary objective of the Surveillance Study was to estimate the baseline prevalence and 1-year incidence of CFS in Wichita, Kansas. Participants in the in-hospital study were fatigued adults with medically/psychiatrically unexplained chronic fatigue identified during the surveillance study. Fifty-eight participants had been diagnosed at least once with CFS and 59 had unexplained chronic fatigue that was not CFS. Controls were randomly selected from the cohort who participated throughout surveillance, who did not have medical or psychiatric exclusions, and who had not reported fatigue of at least 1-month duration; they were matched to CFS cases on sex, age, race/ethnicity, and body

**Table 3: Mean (SD) factorial scores and p-values for sleep questionnaire items in CFS and non-fatigued subjects**

Factor pattern on sleep questionnaire items	CFS (n = 35)	NF (n = 40)	P *
	Mean factor scores (SD) <sup>†</sup>	Mean factor scores (SD)	
<i>F1 Insomnia</i> "How often trouble sleeping", "Waking up before you wanted to", "Sleeping for less than 5 hours", "Difficulty falling asleep", "Repeated awakenings", "Waking up not feeling refreshed", "Restlessness during sleep"	0.54 (0.8)	-0.48 (0.9)	.000
<i>F2 Sleepiness</i> "Falling asleep while sitting and talking", "Falling asleep while doing something, such as driving or talking", "Falling asleep in a car while stopped in traffic", "Falling asleep while sitting and reading", "Falling asleep as a passenger in a car", "Falling asleep while sitting quietly after a lunch", "Falling asleep while sitting inactive in a public place", "Trouble staying awake"	0.27 (1.2)	-0.24 (0.5)	.060
<i>F3 Physical/Somatic</i> "Nightmares or waking up frightened or crying out loud", "Waking up with aches, pains, or stiffness", "Sleeping more than nine hours", "Taking medication for sleep"	0.54 (1.0)	-0.48 (0.5)	.001
<i>F4 Apnea</i> "Interruptions to your breathing during sleep", "Falling asleep while lying down to rest in the afternoon"	0.09 (0.7)	-0.08 (1.2)	.865
<i>F5 Body Clock</i> "Working shifts", "Irregular bed time and/or wake-up time during the work week or weekdays"	0.13 (1.2)	-0.11 (0.7)	.610
<i>F6 Nasal Obstruction</i> "Loud snoring"	0.13 (1.1)	-0.12 (0.8)	.318

\* 2-factor ANOVA, controlling for medication that influences sleep.

† A higher factor score represents more agreement on the sleep questionnaire items comprising the factor (i.e. more sleep complains)

mass index. Upon admission to this study, subjects were re-evaluated for CFS symptoms and exclusionary medical and psychiatric conditions. The 43 who, at the time of the in-hospital study, met 1994 criteria for CFS comprise the cases in this report. Control subjects were 43 individuals who had never reported fatigue during the surveillance study, who were not fatigued at the time of entry into this in-hospital study and who had no exclusionary medical or psychiatric condition identified at the time of the study (following section). Because current classification of CFS was not completely in accord with recruitment classification, strict matching was not maintained, though cases and controls were demographically comparable. Thirty-six (84%) of the 43 with CFS and 38 (88%) of the 43 controls were women; most (40 CFS and 42 controls) were white; their mean ages were 50.6 and 50.3 years, respectively; and body mass index was 29.4 and 29.3, respectively.

**Assessment and classification of CFS:** We classified participants as having CFS at the time of the study based on the empirical application<sup>19</sup> of the 1994 CFS research case definition.<sup>1</sup> We used the Multidimensional Fatigue Inventory (MFI)<sup>21</sup> to evaluate fatigue status; we measured functional impairment with the Medical Outcomes Survey short form-36 (SF-36);<sup>22</sup> and, we used the CDC Symptom Inventory<sup>23</sup> to assess frequency and severity of the 8 CFS defining symptoms. We defined severe fatigue as  $\geq$  medians of the MFI general fatigue ( $\geq 13$ ) or reduced activity ( $\geq 10$ ) scales. We defined substantial functional impairment as scores lower than the 25<sup>th</sup> percentile of published US population on the physical function ( $\leq 70$ ), or role physical ( $\leq 50$ ), or social

function ( $\leq 75$ ), or role emotional ( $\leq 66.7$ ) subscales of the SF-36. Finally, subjects reporting  $\geq 4$  symptoms and scoring  $\geq 25$  on the Symptom Inventory Case Definition Subscale were considered to have substantial accompanying symptoms.

To assess whether medical conditions exclusionary for CFS (including untreated hypothyroidism, sleep apnea, or narcolepsy) had developed since the surveillance study, participants provided a standardized past medical history and a listing of current medications, underwent a standardized physical examination, and provided blood and urine for routine analysis. Medications that affect sleep were considered sleep medications for the purpose of analysis and include: primary hypnotics (zolpidem, temazepam), narcotic analgesics (eg, hydrocodone, oxycodone, propoxyphene), anti-depressants (eg, citalopram, amitriptyline, imipramine, escitalopram, bupropion, venlafaxine, sertraline, paroxetine, fluoxetine), anti-anxiety (alprazolam), anti-histamines (eg, diphenhydramine, chlorpheniramine, promethazine), decongestants (eg, pseudoephedrine, guaifenesin), anti-convulsants (eg, topiramate, clonazepam), anti-sleep phase disorder (melatonin), blood pressure controlling (eg, clonidine, midodrine), anti-psychotics (eg, quetiapine, ziprasidone), stimulants (eg, methylphenidate, modafinil), peristaltic stimulants (metoclopramide), and muscle relaxants (cyclobenzaprine).

To identify psychiatric conditions exclusionary for CFS (current melancholic depression, current and lifetime bipolar disorder or psychosis, substance abuse within 2 years and eating disorders

within 5 years), licensed and specifically trained psychiatric interviewers administered the Diagnostic Interview Schedule for Axis I psychiatric disorders.

We classified participants meeting the 3 criteria (MFI, SF-36, and Symptom Inventory) for CFS and in whom no exclusionary medical (including sleep) or psychiatric conditions were identified as having CFS. Participants whose scores were in the normal range on all of the above mentioned instruments and who had no exclusionary medical or psychiatric conditions identified were classified as non-fatigued. Persons with exclusionary medical or psychiatric conditions were not included in the analysis.

**Objective measures of sleep alterations:** Sleep studies were conducted in a 4-bed clinical research unit at Wesley Medical Center, Wichita, Kansas.<sup>12</sup> These sleep studies consisted of polysomnography on night #1, Multiple Sleep Latency Tests (MSLT) during the following day, and repeat polysomnography on night #2. Patients were asked to arrive 3 hours before their typical bedtime on night #1 to allow adequate time for electrode application and standard bio-calibrations. "Lights out" and "Lights on" time were 22:00 and 7:00, respectively. MSLT began at 11:00 the following morning and consisted of three additional naps at 13:00, 15:00, and 17:00.

Daytime sleepiness was measured with the MSLT, which has demonstrated objective sensitivity to the effects of sleep deprivation, sleep fragmentation, sleep restriction, insufficient sleep hypersomnia, and in disease states such as sleep apnea and narcolepsy.<sup>24,25</sup> Multiple sleep latency tests were performed and scored according to standard guidelines<sup>26,27</sup> with the exception that four naps were recorded. The mean sleep latency on the MSLT was defined as the mean time from lights out to the first 30-second epoch scored as sleep. A sleep onset REM was defined as one or more epochs of REM sleep occurring within 15 minutes of the first epoch scored as sleep. We considered a mean sleep latency <5 min as pathological sleepiness, scores between 5–10 min as a degree of daytime sleepiness (borderline abnormal), and scores of 10–20 min as normal and a lack of daytime sleepiness. Because mean values on the MSLT may adversely be affected by a spurious sleep latency on a single nap opportunity<sup>28</sup> possibly due to what might be perceived as stressful inter-nap activities,<sup>29</sup> median values were also computed for each subject.

Measures of sleep architecture and diagnoses of primary sleep disorders were based upon data from MSLT and the second nocturnal polysomnography (to allow for sleep-lab habituation). Clinical outcomes of polysomnographic assessment and MSLT included obstructive sleep apnea, periodic limb movements, narcolepsy, insufficient sleep syndrome, primary/secondary insomnia, delayed sleep phase syndrome, bruxism, central sleep apnea, and upper airway resistance syndrome.

The polysomnographic outcome variables used in our analyses included: total sleep time (TST) (in min), sleep efficiency (% of time spent in bed asleep), the percentage of TST spent in non-REM (NREM) and REM sleep, latency to sleep onset (in min) to three consecutive epochs of sleep, and REM latency, defined as the time between the first epoch of any stage of sleep and the first epoch of REM-sleep. Brief arousals were scored following criteria set forth by the American Academy of Sleep Medicine, and the number of arousals expressed as a rate per hour of

sleep adjusted for TST. Periodic leg movements both with and without accompanying arousals, were scored according to conventional criteria,<sup>30</sup> and expressed as an index of the rate of leg movements per hour of sleep, and a separately derived index of those accompanied by an American Academy of Sleep Medicine -defined arousal.<sup>31</sup> We further recorded alpha intrusion, which was noted in review of 30-second segments.

Polysomnography data were scored by an Emory University registered polysomnology technologist and interpreted by an Emory University Department of Neurology American Board of Sleep Medicine certified physician.<sup>12</sup>

**Assessment of subjective sleep quality and sleepiness:** During the afternoon of their arrival at the hospital, subjects completed a self-administered questionnaire that explored themes and beliefs regarding sleep. The first two sleep specific questions, taken from the CDC Symptom Inventory,<sup>23</sup> queried frequency and intensity of unrefreshing sleep and problems sleeping during the past month. A score of 0 reflected no difficulty with unrefreshing sleep or no problems sleeping and the maximum score of 16 indicated the problem had occurred all the time and was severe.<sup>see 23</sup> The remaining 24 items of this questionnaire came from the Epworth Sleepiness Scale,<sup>32</sup> which evaluates levels of excessive daytime sleepiness, and from the Toronto Sleep Assessment Questionnaire (SAQ),<sup>33</sup> which measures self-reported sleep quality.

Subjects completed four questionnaires (the Nap Booklets) after each nap on day 1, which assessed latency to fall asleep during each nap. Subjects also completed two questionnaires (the Sleep Booklets) the morning after each overnight study, which evaluated 1) perceived sleep quality the night before on a visual analogue scale from Best possible sleep (equals 0) to Worst possible sleep (equals 140); 2) latency to fall asleep (in min); and 3) total sleep time (in min).

**Statistical analysis:** Differences in categorical demographic data between CFS cases and non-fatigued controls were evaluated by Chi-Square or Fisher's exact test and continuous variables were compared by the t-test. Chi-Square test was also used for comparison CFS cases and non-fatigued controls in sleep study alterations. We used standard logistic regression analysis to regress CDC Symptom Inventory scores (unrefreshing sleep, problems sleeping) as well as Sleep Booklet scores (latency to fall asleep, total sleep time, sleep quality) and sleep medication use (yes/no) on case status (CFS/non-fatigued). Data from all participants was evaluated by logistic regression; in addition the subgroup of subjects with no alterations noted in sleep studies (normal sleep) were evaluated separately.

A two factor analysis of variance (ANOVA) using a general linear model was employed to measure the association between cases status and medication use (yes/no) with polysomnographic variables. Log transformed values of polysomnographic variables were used when necessary to satisfy the assumption of normally distributed outcomes. Mean values for each polysomnographic variable were adjusted for medication use by utilizing the least squares method.

Paired samples t-tests were used to compare 1) mean sleep latency, as measured by the MSLT, and mean sleep latency, as evaluated by the Nap Booklets and 2) latency to fall asleep and total sleep time as measured by nocturnal polysomnography



with latency to fall asleep and total sleep time as measured by the Sleep Booklets. Comparisons were done separately for the group of subjects with CFS and for the non-fatigued controls. P-values for the paired t-tests were adjusted for multiple comparisons using both a Bonferroni correction and by computing a false discovery rate.<sup>34</sup>

Sleep questionnaire data from the SAQ and the Epworth sleepiness scale were z-transformed for multivariate analyses. We used Principal Component Analysis (PCA)<sup>35</sup> with varimax rotation to evaluate which constellation of sleep symptoms represented the majority of the variance in sleep symptoms. Two-factor ANOVA was applied for comparison of factorial scores of sleep questionnaire items between CFS and non-fatigued groups, controlling for sleep medication use (yes/no). Comparison of factorial scores was done for all participants as well as for the subgroup of subjects with normal sleep studies.

Statistical significance for all tests was set at the 5% level. All statistics were computed using SPSS 12.0 (SPSS Inc, Chicago, IL).

## Results

Clinically significant apnea and narcolepsy (exclusionary for CFS) were diagnosed in 11 subjects based on overnight and daytime polysomnographic studies.<sup>12</sup> These subjects were not included in this analysis.

The remaining CFS and control subjects were demographically comparable. Thirty (85%) of the 35 with CFS and 36 (90%) of the 40 controls were women; 32 CFS (91%) and all controls were white; their mean ages were 50.3 (range 27 – 69) and 50.5 (range 32 – 65) years, respectively; and mean body mass index was 28.7 and 29.2, respectively. Medication use was more common in CFS subjects compared to non-fatigued controls; 20 CFS subjects (57%) compared to 5 control subjects (13%) took medications that alter sleep.

Detailed polysomnographic findings have been reported in detail.<sup>12</sup> In brief, previously undiagnosed sub-clinical sleep disorders occurred similarly in both CFS and non-fatigued controls (Table 1). Minimal obstructive sleep apnea and periodic limb movements were the most common alterations and occurred similarly among those with CFS and the controls. MSLT results were also comparable between the two groups. Finally, there were no statistically significant differences in standard polysomnographic measurements between those with CFS and non-fatigued controls on either night 1 or night 2. Since the first night served as an adaptation to the sleep laboratory, Table 2 summarizes only the night-2 data adjusted for medication use. In addition, each group appeared to experience similar periods of wakefulness during the study night as recorded in the % wakefulness during the sleep period.

Our analysis included two questionnaire items from the CDC Symptom Inventory that assess subjective sleep qualities over the preceding month, unrefreshing sleep and problems sleeping (getting to sleep, not sleeping through the night, or waking up on time), as well as one question from the Sleep Booklet, evaluation of sleep quality (best possible sleep to worst possible sleep) during the PSG. In a logistic regression analysis, we found an association of CFS with higher frequencies of symptoms of unrefreshing sleep and problems sleeping ( $p < .001$  for each item) as well as worse ratings of sleep quality ( $p < .05$ );

these associations remained after adjusting for use of medications that affect sleep.

Among subjects with normal objective sleep studies, those with CFS still reported significantly higher frequencies of unrefreshing sleep and problems sleeping than did non-fatigued controls ( $p < .001$  for each item). In addition, CFS subjects with normal sleep studies also rated their quality of sleep during night #2 significantly worse than non-fatigued controls ( $p < .05$ ).

No significant differences between self-reported, as evaluated by the Nap Booklet, and the objective mean sleep latencies, recorded by the MSLT, were found for CFS subjects (Nap booklet score ( $\pm$  SE): 9.3 ( $\pm$  0.9) minutes versus MSLT score : 7.2 ( $\pm$  0.7) minutes, respectively;  $t(7) = 1.7$ ,  $p = .13$ ). In contrast, in non-fatigued controls, self-reported mean sleep latency was significantly longer than recorded mean sleep latency, MSLT score ( $\pm$  SE): 10.8 ( $\pm$  1.5) min versus Nap booklet score :5.8 ( $\pm$  0.6) min, respectively;  $t(16) = 2.9$ ,  $p < .01$ ).

Similarly, self-reported mean latency to fall asleep in non-fatigued controls, as reported in the Sleep Booklets, was significantly longer than mean latency to fall asleep, as measured by overnight polysomnography. These differences were found both on night #1 and night #2 in control subjects, but were more pronounced on night #1. The mean latency to fall asleep on night #1 was 18.9 ( $\pm$  3.5) minutes as measured by PSG, versus mean latency to fall asleep night described in the Sleep booklet 31.8 ( $\pm$  5.2) minutes ( $t(38) = 3.05$ ,  $p < .005$ ). The mean latency to fall asleep on night #2 was 16.6 ( $\pm$  3.5) minutes as measured by PSG, versus latency to fall asleep night described in the Sleep booklet of 23.7 ( $\pm$  4.1) minutes ( $t(38) = 2.4$ ,  $p < .02$ ). In contrast, no significant differences between subjective and objective latency to fall asleep during overnight polysomnography, were found in CFS subjects on either night #1 or night #2. These results remained even after excluding those subjects taking medications that affect sleep. There was no significant difference in total sleep time, as estimated by the Sleep Booklets, and total sleep time, as measured by overnight polysomnography, in either non-fatigued controls or CFS subjects.

Using the conservative Bonferroni correction for multiple comparisons at the  $\alpha = .05$  level, only the difference in night #1 sleep latencies in control subjects would remain significant. However, using the method of Benjamini and Hochberg and controlling the false discovery rate to  $< 10\%$ , then all 3 of the p-values reported above are still significant.<sup>33</sup> Together, these data suggest that altered perception of the latency to sleep onset is common in non-fatigued controls, but not in CFS patients.

Considering all items assessed by the SAQ and Epworth sleepiness scales, Principal Component Analysis (PCA) revealed six factors that accounted for the majority of variability in responses on the sleep questionnaire items. Table 3 shows the individual items comprising the six factors after a Varimax rotation with Kaiser normalization, the mean factor scores, and p-values for the differences between CFS and non-fatigued controls. A higher mean value for a factorial score represents more endorsement of the sleep questionnaire items comprising the factor (ie more sleep complaints). Factor score names were assigned to groups of questions comprising the different groupings based on the domains covered by the individual questions even though the questions were not designed with

specific disorders or disturbances in mind. CFS cases had significantly higher scores in the Insomnia and Physical/Somatic factors compared to non-fatigued controls. CFS cases also had notably higher scores on the Sleepiness factor, although the difference was not statistically significant.

Differences in perception of sleep quality were even more pronounced between CFS cases and controls with normal objective sleep studies. CFS cases not only had significantly higher scores in the Insomnia (CFS: 0.51, non-fatigued: -0.56,  $p = 0.001$ ) and Physical/Somatic (CFS: 0.41, non-fatigued: -0.42,  $p = 0.013$ ) factors, but also in the Sleepiness factor (CFS: 0.39, non-fatigued: -0.27,  $p = .004$ ).

## Discussion

The major finding of this study is the documentation of the extent and nature of sleep complaints experienced by CFS subjects compared to non-fatigued controls in the absence of differences in quantitative polysomnography and multiple sleep latency testing between the two groups. These findings are in agreement with previous clinic-based studies indicating that CFS patients perceive poor sleep in the absence of objective underlying sleep pathology.<sup>11,12,15,16</sup> However, the somewhat paradoxical observation that controls and not CFS subjects, overestimated the time to fall asleep, has not been previously reported and deserves further exploration. This finding suggests that CFS subjects may more closely monitor their sleep behaviour and that may contribute to their perceived sleep problems. It is also possible that persons with CFS are more accurate in their perceptions of their generally impaired sleep than people who do not have insomnia (but may sleep badly from time to time). This finding should be validated in further studies.

Even though identification of insomnia per se was not a goal of the study, it is interesting to note that CFS subjects in this study who were identified by the presence of a prolonged syndromic illness and its consequences also fulfilled a general definition for insomnia.<sup>9,18,36</sup> The symptom variables related to sleep (unrefreshing sleep and the 3 components of problems sleeping: getting to sleep, not sleeping through the night, or waking up on time) were identified by the patients themselves during the construction of the CFS symptom inventory.<sup>23</sup> Do these observations suggest that the CFS subjects have a problem with sleep efficacy, or that their descriptions of symptom association or our efforts to obtain information from them are inadequate? Are the CFS subjects identifying their impairments in terms of sleep based on the types of questions being asked with responses indicative of sleep problems not detected in the usual measures of sleep architecture?

These findings argue against the importance of readily identifiable sleep pathology contributing to the symptoms of CFS in the majority of CFS subjects. However, sleep disorders that may respond to clinical intervention should be evaluated in patients complaining of fatigue, and formal sleep studies are required in the evaluation of patients with suspected sleep disturbances. In clinical practice these disorders would have been considered as temporary exclusions of CFS and the patient re-evaluated after clinical re-evaluation.<sup>8</sup> New clinical interventions in CFS patients await further delineation of possible mechanisms required to explain these differences, but they will likely be based on pharmacological and/or behavioural modalities. However, such interventions need to be based on a

better understanding of sleep physiology and the influences of chronic illness and exclusion of primary sleep disorders.

Besides the theoretical issues addressed above, the present study is not without practical limitations. First, due to stringent selection criteria, our sample size was small, especially considering the number of variables examined. This circumstance limited the power to detect more subtle differences in responses to sleep questionnaire items between groups. Both CFS subjects and controls showed moderately impaired sleep quality (being in a research setting likely impaired sleep quality equally for both groups) and polysomnography is not an optimal measure of insomnia. Further studies with larger sample sizes are clearly warranted. Second, while sleep-altering medications were frequently used by both CFS subjects and controls, their use was more common among CFS subjects. Prescribed medications in CFS subjects may in turn have influenced CFS subjects' reports of sleep quality. Many published studies of sleep in persons with CFS do not consider medication use. Our attempt to statistically adjust for differences in use of medications that affect sleep as a binary measure (use/non-use) might be inadequate to completely control for the confounding effect of medication use. However, our small sample size precluded conducting a stratified analysis among cases and controls who did and did not use medications that alter sleep or whether they medications induced or inhibited sleep. Finally, the mean duration of illness among CFS cases in this population was 7.3 years.<sup>19</sup> Thus, findings in this study of prevalent CFS cases may not be applicable to those with a shorter duration of illness.

## Conclusion

These findings suggest that alterations in standard objective sleep parameters do not explain the etiology of symptoms of unrefreshing sleep and presence of sleep problems reported by persons with CFS who do not have readily diagnosable sleep disorders. Further studies examining the causes of apparent altered sleep-state perception may be helpful in understanding CFS.

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# Insomnia Symptoms and Repressive Coping in a Sample of Older Black and White Women

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## Abstract

**Background:** This study examined whether ethnic differences in insomnia symptoms are mediated by differences in repressive coping styles.

**Methods:** A total of 1,274 women (average age =  $59.36 \pm 6.53$  years) participated in the study; 28% were White and 72% were Black. Older women in Brooklyn, NY were recruited using a stratified, cluster-sampling technique. Trained staff conducted face-to-face interviews lasting 1.5 hours acquiring sociodemographic data, health characteristics, and risk factors. A sleep questionnaire was administered and individual repressive coping styles were assessed. Fisher's exact test and Spearman and Pearson analyses were used to analyze the data.

**Results:** The rate of insomnia symptoms was greater among White women [74% vs. 46%;  $\chi^2 = 87.67$ ,  $p < 0.0001$ ]. Black women scored higher on the repressive coping scale than did White women [Black =  $37.52 \pm 6.99$ , White =  $29.78 \pm 7.38$ ,  $F_{1,1272} = 304.75$ ,  $p < 0.0001$ ]. We observed stronger correlations between repressive coping and insomnia symptoms for Black [ $r_s = -0.43$ ,  $p < 0.0001$ ] than for White women [ $r_s = -0.18$ ,  $p < 0.0001$ ]. Controlling for variation in repressive coping, the magnitude of the correlation between ethnicity and insomnia symptoms was substantially reduced. Multivariate adjustment for differences in sociodemographics, health risk factors, physical health, and health beliefs and attitudes had little effect on the relationships.

**Conclusion:** Relationships between ethnicity and insomnia symptoms are jointly dependent on the degree of repressive

coping, suggesting that Black women may be reporting fewer insomnia symptoms because of a greater ability to route negative emotions from consciousness. It may be that Blacks cope with sleep problems within a positive self-regulatory framework, which allows them to deal more effectively with sleep-interfering psychological processes to stressful life events and to curtail dysfunctional sleep-interpreting processes.

## Background

In the social science literature, ethnicity is often considered a proxy for socioeconomic constructs and sociocultural factors. In the context of sleep medicine, ethnicity might play a unique role in understanding insomnia symptoms. While many objective studies in the U.S. have suggested that individuals of African ancestry have characteristically worse sleep patterns, relative to those of European descent, the preponderance of evidence indicates lower rates of insomnia symptoms among the former. This is evident in two important epidemiologic studies: Duke's Established Populations for Epidemiologic Studies of the Elderly ( $\geq 65$  years old) and the Cardiovascular Health Study of non-institutionalized Medicare enrollees. Specifically, in the Duke's studies 24% of older Blacks complained of sleep disturbances compared to 76% of older Whites. This is consistent with data from the Cardiovascular Health Study, finding that 68% of Whites and 62% of Blacks reported nocturnal awakenings, although the contrast is less striking.

In a more recent study examining ethnic differences in the rate of insomnia symptoms from a community-based sample of older White (40%) and Black (60%) Americans, we found that ethnicity was the best predictor of sleep disturbances. Factors entered in the regression model included sociodemographics, health risks, stress, social support, and mood. Regarding specific reports of insomnia symptoms: difficulty initiating sleep, difficulty maintaining sleep, and early morning awakenings, rates for White men and women were 41%, 75%, and 46%, respectively, whereas for their Black counterparts, rates were 14%, 37%, and 17% respectively. One explanation for this disparity was that reporting biases, commonly noted among older Blacks, might have influenced underreporting of insomnia symptoms. Usually, reporting biases result from difficulties in understanding survey questions, poor recall, and social desirability. Conceivably,

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**Table 1: Demographic and Health Risk Characteristics of Participants**

Variable	Blacks (72%)	White (28%)	F/ $\chi^2$
Mean Age	59 $\pm$ 7	60 $\pm$ 6	4.04
Mean Household Income, K	29 $\pm$ 21	38 $\pm$ 29	31.83**
Mean Body Mass Index	30 $\pm$ 6	28 $\pm$ 6	18.31**
% Married	30	51	46.16**
% High School Degree	76	99	93.44**
% Current Smoking	12	11	0.24
% Social Drinking	18	34	33.25 **

\*\*indicates significant differences using ANOVA or Fisher's Exact test at alpha = 0.01

ethnicity alone might be inadequate as a proxy to explain differences in the rate of reported insomnia symptoms of older adults. This has prompted the need to explore the contribution of psychological factors affecting the likelihood of reporting insomnia symptoms.

Among older adults, several psychological factors (eg, anxiety, depression, and worry) have been shown to affect the sleep process negatively. It is well established that dysfunctional beliefs and attitudes about sleep play an important, mediating role in late-life insomnia. In many cases, they not only predispose individuals to experiencing insomnia but also they can perpetuate it. Arguably, these factors may not of necessity bias the likelihood of reporting an insomnia symptom, although they are fundamental in the onset and maintenance of insomnia. Rather, the type of cognitive appraisal in which one engages while processing life stressors seems to affect the likelihood of experiencing sleep problems and/or biasing subjective report. There is evidence that negative appraisal of life stressors enhances the vulnerability to insomnia. If in effect Blacks use more positive appraisal than do Whites, they may be less vulnerable to experiencing insomnia. Interestingly, appraisal among White individuals has the opposite effect; it often leads to increased psychophysiological distress.

In the present study, we tested the hypothesis that ethnic differences in the report of insomnia symptoms are mediated by variations in repressive coping styles. Repressive coping refers to individuals' ability to distance themselves psychologically from events discretely appraised as negative or situations that threaten their self-concept (see Methods). Lower rates of insomnia symptoms observed among Blacks might reflect a greater ability to regulate negative emotions about the sleep process. We also assessed the influence of health risks, medical morbidities, and beliefs and attitudes on sleep.

## Methods

Data presented in this paper were from a total of 1,274 women participating in a community-based study in Brooklyn, NY. Of the volunteers, 28% were White, which consisted of US-born White women and Eastern-European women from Russia, Ukraine, and Bellarus. The remaining 72% represented an aggregate of Blacks (ie, U.S.-born African Americans and Caribbean Americans, including women born in Haiti, Barbados, Trinidad and Tobago, and Jamaica). The present analyses focus on differences between White and Black participants regarding sleep measures and repressive coping styles.

We used a stratified, cluster-sampling technique to gather representative data for the study. Accordingly, the Household

Income and Race Summary Tape File 3A of the 1990 Census files were used to form census blocks representative of Brooklyn. Blocks were then stratified by ethnicity (Black and White) and by income (high, medium, and low). Once block groups were composed for each stratum, we randomly targeted samples for enrollment from each without replacement.

Trained, quality-controlled interviewers of the same ethnicity as the respondents administered several scales/questionnaires during face-to-face interviews conducted in the volunteer's home or a location of their choosing (usually a church or a senior center). Interviews lasted approximately 1.5 hours, and women completing the study received \$25 for participating. The Internal Review Board at Long Island University approved the study.

Measures for the present analysis included demographic and health risk factors: age, ethnicity, education, income, BMI, smoking status, and alcohol consumption. Physical health was measured with the Comprehensive Assessment and Referral Evaluation (CARE). Repressive coping was assessed with the Index of Self-Regulation of emotion (ISE). Stress was measured by the Stress Index Scale, and volunteers provided information on health beliefs and attitudes.

The CARE has been widely used to assess physical health of older individuals in minority communities. It has shown good construct validity as well as concurrent and predictive validity; sub-scales included in our analyses were: somatic complaint, sleep disorder, leg problems, heart disease, respiratory disease, arthritis, vision problems, and hypertension (Cronbach  $\alpha$  = 0.86; 0.85; 0.86; 0.83; 0.72; 0.91; 0.85; and 0.92, respectively).

Five questions comprise the sleep disorder subscale: "Do you depend on medicine to sleep?"; "Do you have difficulty falling asleep?"; "Do you wake up often during the night?"; "Do you wake up early and wake up feeling tired?"; and "Do you sleep during the day?". A subset of the volunteers (42%) also rated their sleep satisfaction on a scale from 1 (very satisfied) to 5 (very troubled), and estimated their habitual sleep duration, time spent in bed, time to bed, and final wake-up time. Insomnia symptom was defined as a report of either difficulty initiating sleep, difficulty maintaining sleep, or early morning awakening. No formal insomnia diagnosis could be formulated, as data on frequency, duration, or severity was not elicited.

The Index of Self-Regulation constitutes a modified version of Weinberger's conceptual model of repression. According to Mendolia's research, the model stipulates that the interaction of individual differences in emotional responsiveness and situational threats to self-concept contributes to one's tendency

**Table 2: Comparison of Reported Health Problems by Ethnicity**

Variable	Black (72%)	White (28%)	$\chi^2$
Respiratory Disease (%)	29	52	60**
Hypertension (%)	57	41	26**
Heart Disease (%)	41	55	20**
Arthritis (%)	67	73	4**
Leg Problem (%)	52	61	8**
Vision Problem (%)	54	28	67**
Somatic Complaint (%)	60	81	52**

\*\*indicates significant differences using Fisher's Exact test at  $\alpha = 0.01$

to regulate emotional responsiveness. This model of repressive behavior posits that repressive copers are hypersensitive to both negative and positive emotional events, but they distance themselves from these events only when the situation threatens their self-concept. Repressive coping refers to a person's belief that he or she is capable of conforming to rigid standards of self-control.

Mendolia's model represents an extension of conventional categorical measures of repression, which might not yield an accurate representation of observed variations in repressive coping. This revised model accounts for the motivation and conditions in which repressors use a perceptual defense in response to negative and positive emotional events. In our analysis, ISE scores were derived following Mendolia's conceptualization, which amalgamates the defensive scale of the Social Desirability Scale ( $\alpha = 0.73$ ) and the anxiety subscale of the State-Trait Anxiety Inventory ( $\alpha = 0.75$ ). Scores range from 0 to 52, with higher scores representing greater defensiveness/repressive coping. According to this classification scheme, individuals have a repressive coping style when they are highly defensive (eg, high score on the social desirability scale, but also low in trait anxiety (eg, low score on the manifest anxiety scale). Details on the derivation of ISE scores as used in our analysis have been reported elsewhere.

The Stress Index Scale used initially by the National Survey of Black Americans was administered to our participants. Respondents rated on a 4-point scale the degree to which a set of items provoked stress in the past month or two. These stress-induced life events were health, money, job, problems with family or marriage, problems with people outside the family, children, crime, police, love life, and racial conflict. Scores ranged from 0 to 29, and higher scores denoted greater stress levels ( $\alpha = 0.81$ ). Additionally, for the purpose of our analyses we selected five questions from the 'Health Practices' and 'Beliefs and Attitudes Toward Health' questionnaires. These included three items assessing help-seeking behavior: 1) seeking

help from a religious healer, 2) seeking help from a spiritualist or a neighborhood healer, and 3) regular annual physical exams. The other two assessed religious faith as a coping strategy to deal with life challenges: 2) praying is the best way to cope with health problems and 2) God will take care of me when ill.

### Statistical analysis

Frequency and measures of central tendency were used to describe the sample. Variables were examined for normality and tested for collinearity, and those that were non-gaussian were transformed using appropriate statistical techniques. Analysis of variance was used to assess ethnic differences on continuous variables. Fisher's Exact test was employed to assess effects of ethnicity on insomnia symptoms, health measures, help-seeking behavior, and religious faith.

Spearman correlations were used to explore relationships between ethnicity and sleep measures and ISE scores and between ISE scores and sleep measures. Since ethnicity and ISE were correlated, we performed partial correlations to assess associations of ethnicity with sleep measures, controlling for variations in ISE scores. In separate partial correlation analyses, we explored whether differences in demographic factors (i.e., age, education, income, and marital status) or health factors (i.e., somatic complaint, heart disease, respiratory disease, arthritis, leg problem, vision problem, and hypertension) would have any mediating effects on associations of ethnicity with sleep measures. We also examined whether variations in help-seeking behavior and religious faith would influence these associations. Furthermore, relationships of ethnicity and ISE scores to insomnia symptoms were also examined using logistic regression analysis.

Since we examined relationships between many variables, we assessed a priori what significance criterion could be accepted using an observed probabilities plot (p-plot). The p-plot indicated that correlations with a probability less than 0.04 could be regarded as unlikely to be due to chance. Thus, acceptance of probabilities  $\leq 0.01$  in the present analyses represents a conservative criterion, thus limiting the likelihood of a Type I error. This is consistent with application of a Bonferroni adjustment to the largest correlation matrix (nine variables) in our analyses, which indicated that probabilities  $\leq 0.01$  would be acceptable.

### Results

In Table 1, we compare the demographic and health risk characteristics of the sample based on ethnicity. Significant ethnic differences in income, percent of women with a high school degree, percent married, and percent of social drinking were found, but no significant ethnic effect on the rate of

**Table 3: Comparison of Help-Seeking Behavior and Religious Faith by Ethnicity**

Variable	Black (72%)	White (28%)	$\chi^2$
Annual Physical Exam (%)	87	85	0.94
Help from a Religious Healer (%)	5	5	0.06
Help from a Spiritualist (%)	2	3	0.54
Healers Treat Health Problems (%)	35	18	38**
Herbs Have Healing Values (%)	58	44	20**
Prayer Helps with Health Problems (%)	85	31	342**
God Takes Care of Me When Ill (%)	77	34	208**

\*\*indicates significant differences using Fisher's Exact tests at  $\alpha = 0.01$ .



**Table 4: Comparison of Insomnia-Related Symptoms by Ethnicity**

Variable	Black (72%)	White (28%)	$\chi^2$
Difficulty Initiating Sleep (%)	16	42	86**
Difficulty Maintaining Sleep (%)	40	64	60**
Early Morning Awakening (%)	27	53	81**
Daytime Sleep (%)	9	4	9*
Sleep Medicine (%)	4	19	83**

\*\* indicates significant differences using Fisher's Exact tests at  $\alpha = 0.01$ ; \* at  $\alpha = 0.05$ .

current smoking was found. Stress levels were comparable for Blacks and Whites [Black =  $9.32 \pm 6.61$  and White =  $9.80 \pm 5.66$ ,  $F_{1,1273} = 11.48$ , NS]; thus, stress was not considered in partial correlations. As seen in Table 2, White participants reported significantly greater rates of somatic complaints, respiratory problems, arthritis, heart diseases, and leg problems, whereas Blacks reported significantly greater rates of hypertension and vision problems.

We found no significant ethnic differences in help-seeking behavior (see Table 3). Despite the fact that more Blacks believe that a religious or spiritual healer can treat illnesses, they did not disproportionately seek their help. A significantly higher percentage of Blacks believed that prayer is the best way to cope with health problems and that God takes care of them when ill. Although more Blacks believed that herbal medicines have healing values, few of those sharing these beliefs actually used herbs to treat mild health conditions [14%] and even fewer for serious conditions [1.5%]. Among Whites with similar beliefs, 39% used herbs for mild conditions and 1.9% for serious conditions.

Overall, the percentage of White women reporting insomnia symptoms was greater than that of Blacks [74% vs. 46%;  $\chi^2 = 87.67$ ,  $p < 0.0001$ ;  $r_s = 0.26$ ,  $p < 0.001$ ]. Rates for each sleep-related complaint are compared in Table 4, showing significantly greater rates for Whites with regard to difficulty initiating sleep, difficulty maintaining sleep, early morning awakening, and use of sleep medicine, except for daytime sleep, which was more prevalent among Blacks. Moreover, Black ethnicity correlated with greater sleep satisfaction [ $r_s = 0.20$ ,  $p < 0.001$ ], and earlier rise time [ $r_s = 0.18$ ,  $p < 0.001$ ] and bedtime [ $r_s = 0.17$ ,  $p < 0.001$ ]. Trends suggested longer sleep duration and better sleep quality for Blacks as well [ $r_s = -0.10$ ,  $p = 0.04$ ;  $r_s = -0.11$ ,  $p = 0.02$ , respectively].

Generally, women with greater scores on the repressive coping scale (ISE) reported fewer insomnia symptoms [ $r_s = -0.44$ ,  $p < 0.001$ ], greater sleep satisfaction [ $r_s = -0.28$ ,  $p < 0.001$ ], slept

longer [ $r_s = 0.20$ ,  $p < 0.001$ ], and had better sleep quality [ $r_s = 0.34$ ,  $p < 0.001$ ]; bedtime and rise time were relatively unaffected by variations in repressive coping. Since Black women showed greater ISE scores than White women [Black =  $37.52 \pm 6.99$  and White =  $29.78 \pm 7.38$ ,  $F_{1,1272} = 304.75$ ,  $p < 0.0001$ ], we examined relationships of ISE with insomnia within each ethnic group. Black women characterized by greater ISE scores reported lower rates of insomnia [ $r_s = -0.43$ ,  $p < 0.0001$ ]. Within the White ethnicity, women with greater ISE scores also reported lower rates of insomnia [ $r_s = -0.18$ ,  $p < 0.0001$ ]. Notably, the magnitude of the correlation coefficient was smaller, but this was not confounded by larger cell size for the Black group.

Since both ISE and ethnicity were associated with sleep measures, and that Black women tended to have greater ISE scores, we assessed whether ethnicity would remain a significant correlate of sleep measures controlling for variations in ISE scores. Partial correlation analyses showed that the magnitude of the relationship between ethnicity and insomnia, sleep satisfaction, rise time, and bedtime was substantially reduced [ $r_p = 0.09$ ,  $p < 0.01$ ;  $r_p = 0.10$ ,  $p < 0.01$ ;  $r_p = 0.14$ ,  $p < 0.01$ ;  $r_p = 0.08$ ,  $p < 0.01$ , respectively]. Correlations with sleep duration and sleep quality were too weak for any meaningful interpretation; thus, they were not included in partial correlations.

Controlling for effects of age, income, education, marital status, and BMI did not result in significantly lower correlations between ethnicity and insomnia, sleep satisfaction, and rise time [ $r_p = 0.22$ ,  $p < 0.01$ ;  $r_p = 0.17$ ,  $p < 0.01$ ;  $r_p = 0.17$ ,  $p < 0.01$ , respectively], except for bedtime [ $r_p = 0.07$ , NS]. Similarly, with control for variations in help-seeking behavior and religious faith, we did not find substantial changes in the correlations [ $r_p = 0.20$ ,  $p < 0.01$ ;  $r_p = 0.17$ ,  $p < 0.01$ ;  $r_p = 0.14$ ,  $p < 0.01$ , respectively], except for bedtime [ $r_p = 0.06$  NS]. With multivariate adjustment for differences in health characteristics, the correlations were largely unaffected: [ $r_p = 0.19$ ,  $p < 0.01$ ;  $r_p = 0.13$ ,  $p < 0.01$ ;  $r_p = 0.16$ ,  $p < 0.01$ , respectively]; for bedtime, it was [ $r_p = 0.05$ , NS].

**Table 5: Associations Between Medical Factors and Insomnia Symptoms**

Variable	Wald	OR	CI
Arthritis	17.91**	2.10	1.49 – 2.97
Hypertension	0.17	1.07	0.77 – 1.50
Heart Disease	2.51	1.33	0.94 – 1.88
Vision Problem	3.00	1.32	0.96 – 1.82
Respiratory Disease	28.83**	2.35	1.72 – 3.21
Leg Problem	19.66**	2.05	1.49 – 2.82
Somatic Complaint	34.68**	2.81	1.99 – 3.96

Adjusted odds ratios (OR) derived from regression of the insomnia measure on medical factors. \*\*  $p < 0.01$

Given the ethnic disparity in medical morbidities (see Table 2), we assessed independent associations of ethnicity and ISE scores with insomnia symptoms using logistic regression analysis with insomnia symptoms as a binary variable. These analyses indicated that being White [OR = 1.79; CI: 1.32–2.41] and a low regulator (low ISE scores) [OR = 5.30; CI: 4.09–6.87] were significant independent predictors of the likelihood of reporting insomnia symptoms. With multivariate adjustment for medical factors, adjusted odds ratios for ethnicity and ISE were 2.01 (CI: 1.39 – 2.92) and 2.84 (CI: 2.09 – 2.85), respectively. Adjusted odds ratios for each of the medical morbidities are indicated in Table 5; somatic complaint was the most important contributor.

## Discussion

The main objective of our research was to ascertain which factors are associated with sleep problems among older adults living in Brooklyn communities. The first observation in the present study was that Black women reported significantly fewer insomnia symptoms than did White women. This was also true in our previous study of Brooklyn residents, despite the age disparity in the sample. One implication of this finding is that ethnic effects on rates of insomnia symptoms are also observable among younger women. There is no reason to suspect that similar effects would not be found among younger men as well. This finding is consistent with available epidemiologic evidence that Blacks generally report fewer insomnia symptoms relative to age-matched Whites. In all, the proportion of White women in Brooklyn, NY reporting insomnia symptoms was 62% greater than for Black women.

Other related findings were that Black women seemed to retire and got up earlier than did Whites and that Blacks might have experienced longer and more satisfying sleep than their White counterparts. Trends regarding longer sleep time for Blacks are in line with data from the National Health and Nutrition Examination Survey, showing that more Blacks (11%) than Whites (8%) reported sleeping more than 8 hours, the recommended sleep time by the National Sleep Foundation. About a decade earlier, the National Health Interview Survey estimated that sleep length greater than 8 hours was also greater among Blacks (18%) relative to Whites (11%). On balance, we should also consider evidence suggesting that sleeping less than 6 hrs might be more prevalent among Blacks; thus sleep time might be more variable among Blacks. Definitive conclusions regarding longer sleep time among Blacks await objective, population-based studies.

While the amount of sleep experienced by the U.S. adult population decreases steadily, sleep complaints seem to have increased commensurately, causing public health advocates to be concerned about the likelihood that different segments of the population might be at greater risks for adverse effects of sleep restriction. A cursory view of the available epidemiologic evidence within the context of ethnicity would have suggested that Blacks are at lower risks compared to Whites, as the former report fewer insomnia symptoms and being generally more satisfied with their sleep. However, considering clinical evidence that White patients often sleep longer than do Blacks with the same sleep disorder diagnosis, it is unclear whether Blacks are in fact at lower risks for adverse effects of sleep loss.

Absent empirical verification of those findings then, we cannot affirm with certitude why Blacks reported fewer insomnia

symptoms. Initially, we had suspected that higher rates of insomnia symptoms among White women could be attributed to their report of more medical comorbidities as reflected by higher rates of arthritis, respiratory disease, and heart disease; these are often associated with sleep disturbances. However, based on regression analysis ethnic effects persisted even after multivariate adjustment for ethnic disparities in physical health. It does not appear that differences in reported sleep or health complaints are explainable on the basis of differing socioeconomic or immigration status. Analysis of the previous Brooklyn data revealed that such factors were not significant independent predictors of sleep disturbance. Differences could not be explained by ethnic variation in help-seeking behavior, as Blacks were as likely as Whites to receive a yearly physical exam. We observed important differences in religious and cultural beliefs, but they did not have independent effects on sleep profiles. Although women in both groups believed that prayer is the best way to cope with health problems, belief in God did not influence rates of insomnia symptoms.

The second main finding of the study is that the relationship of ethnicity to insomnia and sleep satisfaction is jointly dependent on the degree of repressive coping. With control for effects of repressive coping, the magnitude of the relationship of ethnicity to insomnia and sleep satisfaction diminished, indicating that repressive coping was indeed a mediating factor. Such was not the case when we controlled for effects of sociodemographics, medical factors, health risk characteristics, or help-seeking behavior. This suggests that Black women reported fewer insomnia symptoms because of a greater ability to regulate their emotions. It may be that Blacks cope with sleep problems within a positive self-regulatory framework, which allows them to deal more effectively with sleep-interfering psychological processes to stressful life events and to curtail dysfunctional sleep-interpreting processes. If indeed Blacks are better appraisers of daily stressors negatively affecting the sleep process, this attribute would reduce their vulnerability to insomnia particularly where anxiety constitutes the dominant feature. It is of interest to determine whether self-reported and physiologically monitored sleep patterns differ greatly among individuals showing divergent repressive coping styles.

The explanation for the lower rates of insomnia symptoms among Blacks formulated in our previous report pointed to appraisal research, which shows that Blacks use more positive reappraisal than do Whites. In light of new data, we revise our previous explanation using repression theories. The current explanation does not negate the one previously articulated; it clarifies it. The finding that Blacks report fewer insomnia symptoms does not reflect of necessity a response bias, as might be motivated by greater social desirability, although repressors are inclined to behave in socially desirable ways. It does not appear that our method of gathering data offered the motivational and situational antecedents to elicit such behavior. Trained staff of the same ethnicity as the respondents conducted interviews soliciting non-threatening information in a place of their choice. Besides this consideration, one imagines that the resulting incongruence between underreporting of sleep problems and the actual sleep experience, if deemed unsatisfactory, would probably be itself a precipitating factor in the onset of insomnia. Generally, Blacks may not be under-reporting insomnia symptoms at all. Rather, the regulatory style they employ as they approach the sleep experience may actually serve to offset the adverse effects of negative affect on sleep.

There may be two mechanisms by which the sleep experience of older Blacks differs from that of older Whites. It is likely that life stressors, which ordinarily induce negative cognitive-affective dispositions, do not readily influence the sleep process of highly regulated Blacks. In this regard, the underlying motivation for repressive coping is to protect the sleep process by not permitting access to the memory of negative emotional events, potentially impinging on one's ability to initiate and/or maintain sleep. This would be in line with the view that late-life insomnia is perpetuated by negative attitudes and beliefs about sleep, which can be successfully addressed with cognitive behavior therapy. As adapted by sleep clinicians, the use of this therapeutic modality facilitates reduction of dysfunctional beliefs (or self-perceived stress), which can obviate insomnia symptoms even among individuals with severe insomnia.

It is equally likely that Black repressors are more adroit at distancing themselves psychologically from a sleep experience discretely appraised as negative. Regardless of the type of sleep experienced, it would be deemed satisfying, thus forestalling any triggers of conditioned insomnia resulting from a negative emotional reaction to poor sleep. This idea is consistent with previous findings that some self-described normal sleepers may endure severe sleeping difficulty with no corresponding reports of insomnia symptoms. Repressive coping in this context would entail a greater dissociation from the somatic reaction to poor sleep and the personal distress with which it is associated. It was interesting that not only did Black women show higher self regulation, they also reported fewer somatic complaints, supporting a previous report of attenuated somatic symptomatology among repressors. If indeed, Black repressors are poor encoders of negative experiences, as would be predicted by thought-suppression experimental paradigms, the failure to report insomnia symptoms may in fact imply poor recall ability due to inadequate depth of processing or retrieval inhibition. One wonders whether repressors with an insomnia diagnosis could accurately assess their sleep profile immediately upon experimental awakening permitting no opportunity to maintain congruence with previous reports of sleep profile.

In sum, each of the proposed mechanisms employs inhibitory strategies, one preempting the devastating effects of negative cognitive-affective dispositions on sleep, and the other disallowing any perpetuating effects of a negatively appraised sleep experience. Whatever the mechanism at work, their modus operandi is to reduce the likelihood that sleep problems would predominate the awareness of repressive copers.

Whereas Blacks with insomnia symptoms may benefit from this unique ability to cope with challenges posed by sleep disturbances, this may be maladaptive among those suffering from sleep apnea or other medical conditions causing insomnia. There are data suggesting that the repressive coping style, consisting of a constant presentation of a highly positive and optimistic self-image, may be psychologically maladaptive. Repressive individuals reporting low level of anxiety have been found to exhibit high level of anxiety based on physiological tests, and some may be unusually sensitive to anxiety-provoking information. Perhaps, the propensity not to address sleep problems might explain in part why sleep apnea is a public health problem in Black communities. One population-based study, comparing community-dwelling older Blacks and Whites, found that Blacks were experiencing severe sleep apnea with a

relative risk twofold as great (relative risk = 2.13) as that of their White counterparts. Yet, data we collected at a sleep clinic in Brooklyn suggest that only 35% of Blacks are likely to comply with a doctor's recommendation to undergo a polysomnographic evaluation. This is quite alarming since 91% of Black patients in that clinic who consented to be evaluated received a diagnosis of sleep apnea. It is estimated that more than half of Blacks with sleep apnea may be unaware of it.

## Conclusion

Plausibly, gradual sleep loss along with commensurate increases in insomnia symptoms affects Blacks and Whites proportionately. Which group is at greater risks for adverse events is yet undetermined. Results of our study lead to the realization that, on the one hand, the ability of older Blacks to cope more effectively with insomnia challenges, if proven, would constitute an important asset. On the other hand, the failure to recognize sleep disturbances when accompanied by medical and/or psychiatric comorbidities represents a liability for Blacks.

This liability is manifest when we consider the consequences of untreated sleep apnea, which might include increased odds of involvement in a motor vehicle accident and vulnerability to hypertension, cardiovascular diseases, and type 2 diabetes mellitus, or early mortality. Since individuals belonging to the Black ethnicity are at greater risks for sleep apnea, they would benefit from increased efforts to improve awareness of the importance of early detection of this condition. Whereas there is no direct evidence to encourage Blacks to sleep longer than the current population mode, it seems a prudent practice that they avoid acute sleep loss as they may be at greater risks for adverse events.





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