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SLEEP

Few things in life are as cherished as a good night's rest. Yet, for many older adults, bedtime is the hardest part of the day (National Institute on Aging, 1990). Strong biological, clinical, and epidemiological evidence exists that indicates sleep is affected by the aging process (Ancoli-Israel & Kripke, 1986; Dement, Miles, & Carskadon, 1982; Feinberg, 1974; Kales, Wilson, & Kales, 1967; Kahn & Fischer, 1969; Kahn, Fischer, & Lieberman, 1970; Kripke, Ancoli-Israel, Mason, & Messin, 1983; Kripke, Simons, Garfinkel, & Hammond, 1979; McGee & Russell, 1962; Miles & Dement, 1980a; Miles & Dement, 1980b; Prinz, 1977; Reynolds et al., 1985b). Moreover, changes in sleep are frequent concerns among older adults and their caregivers (Colling, 1983; Dement, Miles, & Carskadon, 1982; Hayter, 1983). The ongoing study of sleep in late life is vitally important for several reasons. First, a large proportion of elders suffer sleep disturbances. Older adults constitute the age group most severely affected by disorders of initiating and maintaining sleep and consume disproportionate quantities of sleeping pills and tranquilizers. Very often, nighttime insomnia (and/or the medication used to "relieve" it) leads to significant deterioration in daytime alertness and functioning (Carskadon & Dement, 1981a; Dement, Miles, & Carskadon, 1982), and a significant degree of distress is caused. Additionally, many daytime complaints and health problems seen in late life may be related to specific sleep disorders. Until recently, changes in sleep have been associated with the normal aging process. However, new research data indicate that many of the sleep changes in elders may be pathologic and amenable to intervention. Second, older persons who have sleep disturbances provide a sample that can be used to study aging effects in general, effects that are likely to be most clear-cut in the "old-old" and that may provide clues to improving the health and quality-of-life of all late-life age groups. In this context, the two most common neuropsychiatric disorders of late life, depression and dementia of the Alzheimer's type, are both associated with profound disturbances in sleep and often with impaired alertness during the day (Fineberg, Koresko, & Heller, 1967; Prinz et al., 1982a; Reynolds et al., 1985c). Further, many of the ills of old age (or their treatment) have a negative impact on the ability to achieve long uninterrupted periods of sleep and adequate depth of sleep, thus compounding the distress associated with chronic medical diseases. Third, studies have suggested that sleep-related behaviors often precipitate a family's decision to institutionalize an elderly relative (Rabins, Mace, & Lucas, 1982; Sanford, 1975). Any understanding that would help reduce the institutionalization rate would pay for itself many times over. The benefits that could accrue from understanding how the aging system mediates the deteriorations observed in the health and well-being of older adults, including sleep, would have an impact not only on older persons themselves but on society as a whole. The following discussion describes sleep and the measurement of sleep; provides a comprehensive review of sleep and aging research; and suggests directions for future nursing research studies on sleep and older adults (see page 118 for a glossay of terms).

State of the Science

Sleep and Measurement

Sleep is a set of complete physiological processes involving a predictable sequence of operating

states within the central nervous system identified by electroencephalographic (EEG) patterns and by specific behaviors (Hoch et al., 1989). Sleep is measured objectively by EEG recordings or observational methods and subjectively through self-reports. EEG sleep is typically recorded in a laboratory during nocturnal and/or daytime sleep periods and requires a minimum of at least one full night of recording. Laboratory study provides objective and accurate data about sleep variables. These studies are limited, however, because of the necessity for expensive equipment and technical proficiency in obtaining and interpreting results, and because the person is removed from the normal sleep milieu. Portable recording methodologies are also available for use in community settings. Portable technologies provide accurate data but are restricted in number and type of EEG variables that can be recorded. EEG sleep recordings can be scored by hand or by automated computer analysis. Variables include measures of sleep continuity, sleep architecture (stages of non-rapid-eye-movement (NREM) sleep), and rapid-eye-movement (REM) sleep. Both REM sleep (dreaming sleep) and NREM sleep (quiet sleep) are part of the normal sleep cycle. Everyone has about four to five cycles of REM and NREM sleep per night. For older persons, the amount of time spent in the deepest stages of NREM sleep decreases. This may explain why older people are thought of as light sleepers (National Institute on Aging, 1990). Additional variables generally recorded during nocturnal EEG monitoring are nocturnal myoclonus or periodic leg movements and measures of breathing including apnea, hypopneas, and oxygen desaturations. Observational methods are used in institutional settings. Periodic or continuous monitoring of sleep behaviors is done by direct personal observations or through video recordings. Observations are recorded on data forms and are typically categorical and descriptive. Observational study is less expensive than EEG recordings but yields less precise data and introduces questions of rater reliability and bias. Subjective self-report data is collected through questionnaires or interviews including sleep logs, post-sleep questionnaires, and surveys on sleep habits and sleep quality. Self-reports are valuable sources of information because they reflect an individual's attitudes, beliefs, and perceptions about his or her sleep and indicate problem areas. Data are, however, estimates.

Sleep and Aging Research

Sleep and aging research over the past decade has yielded many exciting and promising discoveries about sleep patterns, sleep structures, and subject sleep evaluations using methodologies described above. Several key areas of sleep research with older persons have emerged: 1) normal" or "healthy" aging; 2) pathologic aging (generally neuropsychiatric disorders of late life); 3) specific sleep disturbances (sleep-disordered breathing, nocturnal myoclonus, excessive daytime sleepiness, insomnia); 4)sleep problems in the nursing home; and 5) mortality.

Sleep and Healthy Aging. Research studies have consistently documented the following EEG sleep patterns among the healthy older adults: fragmented sleep with increased NREM Stages 1 and 2 sleep; decreased NREM Stage 4 (deep) sleep; and decreased absolute amounts of REM sleep (Feinberg, 1974; Fineberg, Koresko, & Heller, 1967; Hayashi & Endo, 1982; Kahn & Fischer, 1969; Kales, Wilson, & Kales, 1967; Prinz, 1977; Reynolds et al., 1985c). The nocturnal sleep of older persons is brittle and shallow; that is, it is characterized by numerous transient arousals (3-15 seconds) and by a loss of the deepest levels of NREM sleep (Miles & Dement, 1980a). In addition, the sleep of older persons is often redistributed around the clock, as evidenced by both the fragmentation of nighttime sleep, the occurrence of daytime naps, and an advanced sleep phase (going to bed earlier and getting up earlier). Even if the ability to have slow-wave sleep and long noninterrupted sleep periods declines with age the issue of ability to sleep versus need for sleep is not settled. That is, do older people sleep less because they need less sleep, or because they cannot sleep as well as younger adults? Currently, research evidence favors the view that elders have less ability to sleep rather than less need for sleep. Hence, the occurrence of daytime sleepiness in many older people may be a manifestation of unmet sleep need. Yet, recent research also suggests that some aspects of age-related sleep deterioration are reversible. Thus, following sleep deprivation or sleep restriction (i.e., systematically spending less time in bed), older persons show

an ability to generate recovery sleep with increased amounts of slow-wave sleep and improved sleep continuity (Hoch et al., 1987a; Reynolds et al., 1986a; Spielman, Saskin, & Thorpy, 1983). Gender-related differences also have been noted in the sleep of healthy older people. Elderly men show more impaired sleep maintenance and less slow-wave sleep than elderly women (Reynolds et al., 1985b; Williams, Karacan, & Hursch, 1974). However, older women are more likely than men to complain of sleep disturbance and to receive sleeping pills (Miles & Dement, 1980b). An explanation of this paradox may lie in gender-related differences in sleep perception and effects of sleep disruption on mood. Research has shown that elderly women show higher and more stable correlations between estimates of sleep quality and objective laboratory measurements of sleep (Hoch et al., 1987a), and that elderly women find sleep deprivation to be a more mood-disturbing experience than elderly men (Reynolds et al., 1986a). It is possible that elderly women may be more sensitive to sleep quality and sleep loss than elderly men. To determine if advancing age continues to affect the stability of sleep structure and reports of sleep quality, longitudinal studies of sleep in healthy elders have been initiated. Hoch and colleagues (1988) measured EEG sleep characteristics and perceptions of sleep quality of healthy elders at two-year intervals. In this study, most laboratory measures of sleep and measures of sleep quality were stable over two years. Both elderly men and women showed significantly more awakenings during the second recording series; however, there was no change in visual or computer-scored delta activity. Further, gender-dependent sleep changes were noted only in phasic REM measures. Activity, density, and intensity increased in men over time and decreased in women. Subjective estimates of sleep quality, although stable over time, showed gender-dependent differences with women reporting a lower sleep quality than men.

Sleep and Pathologic Aging. Depression and dementia are two of the most serious and prevalent neuropsychiatric disorders of old age. Sleep disturbances are among the most frequent and disturbing features of depressed and demented older adults (Prinz et al., 1982a; Prinz et al., 1982b; Reynolds et al., 1985c). Sleep research in affective illness, particularly in late-life depression, has advanced over the past decade, resulting in a growing body of objective data concerning EEG sleep changes associated with depressive illness. The sleep of Alzheimer's patients in varying stages of the disease has been studied. Information concerning the specificity of EEG sleep changes in late-life depression, compared with other neuropsychiatric disorders such as probable Alzheimer's dementia as well as "healthy" (pathology-free) aging, is now available. Interactions between aging and illness determine the sleep characteristics of depression (Gillen, Duncan, & Murphy, 1981; Kupfer et al., 1982). The sleep changes that characterize depression also occur during the course of normal aging, but to a lesser extent. For instance, an age-dependent increase in wakefulness after sleep onset and decrease in slow-wave sleep characterize both normal aging and depressive illness. It is less clear whether REM sleep latency shortens during the course of normal aging (as it does to a considerable extent in depression) and if it does, how robust a trend this may be (Kupfer, Frank, & Ehlers, 1989). However, it is recognized that the tendency for REM sleep periods to become progressively longer during the night is significantly less in older healthy persons than in young adults. Apparently, the capacity to sustain REM sleep inhibition during the first half of the night is diminished by advancing age and, to a greater extent, by the presence of depressive illness. Hence, abbreviation of REM sleep latency and alteration of intranight temporal distribution of REM sleep (with greater early REM sleep density) most specifically characterizes the sleep of older patients with major depressive disorders. These changes in REM sleep cycling and density are more marked in depressives in late-life than at any other age. It has been demonstrated that short REM latencies, prolonged first REM periods, and extreme sleep maintenance difficulty reliably characterize the EEG sleep of elderly unipolar, nondelusional, and endogenous depressed older adults (Reynolds et al., 1983; Reynolds et al., 1985c). One of the findings from these studies has been the high frequency of sleep onset REM periods (SOREMP's) in elderly endogenous depressives, where approximately 45 percent of REM latency values are less than ten minutes as compared with less than two percent in healthy controls and 17 percent in nondepressed Alzheimer's patients. The sleep maintenance difficulties of depressed older people

also correlated significantly with the severity of depression, as measured by Hamilton depression ratings (Hamilton, 1967). A concomitant finding was that the extent of cognitive impairment in depressed older adults, as measured by the Folstein mini-mental state (Folstein, Folstein, & McHugh, 1975), was significantly and positively correlated with the amount of Stage 1 sleep, another measure of sleep fragmentation.

The response characteristics and regulatory integrity of the sleep system in late-life depression have been elucidated further by the use of sleep deprivation research protocols as both clinical and physiologic probes. Sleep deprivation techniques have been used also to characterize the sleep of elderly depressives as compared with healthy controls and individuals with dementia of the Alzheimer's type (Reynolds et al., 1987). For example, during recovery sleep following a 36- to 40-hour total sleep deprivation procedure, time spent asleep and sleep efficiency were increased in depressed and demented patients as well as in healthy controls. However, neither of the patient groups achieved even baseline control levels of sleep efficiency or time spent in sleep. Further, the depressed patients had the lowest sleep efficiency throughout recovery sleep. Depressed patients also differed from the other groups with respect to the temporal distribution of delta wave activity, showing the greatest amount in the second NREM period. REM responses to sleep deprivation likewise differed among the three groups, with both depressed and demented patients experiencing increased REM latency during recovery sleep and healthy subjects experiencing decreased REM latency.

Self-reported measures of sleep disturbances and depressed feelings in community resident elders also support an interactive relationship between sleep regulation and depression. A recent longitudinal study examined the association between frequency of depressed mood and self-reports of sleep problems (difficulty falling asleep, waking up frequently in the night, early morning awakening, not feeling rested in the morning) in a group of community-residing elders over a three-year period (Rodin, McAvay, & Timko, 1988). The investigators found that frequency of depressed feelings was related to moderate and severe levels of sleep disturbance, with early morning awakening emerging as the sleep problem most consistently associated with depressed affect over time. This finding is consistent with electroencephalographic investigations that have suggested the importance of early morning awakenings as a key sleep symptom among elderly depressives (Kupfer et al., 1982; Kupfer et al., 1989). Moreover, the presence of early morning awakenings has also been shown to correlate with severity of depression and to predict reversible dementia (pseudodementia) versus primary degenerative dementia with depressive features (Reynolds, et al., 1986b).

Disturbed sleep and sleep/wake cycles are common occurrences in individuals with Alzheimer's disease. These disturbances often result in disrupted nocturnal behaviors such as nighttime insomnia, wandering, and sundowning. The impaired sleep/wake patterns associated with Alzheimer's dementia may result from loss of or damage to the neuronal pathways that initiate and maintain sleep (Prinz et al., 1982b). Brainstem regions and pathways that regulate sleep/wake cycles may undergo degenerative changes in Alzheimer's disease; similar changes also may occur in the cortical tissues that generate EEG slow-wave activity during sleep. Elderly individuals with dementia as compared with controls have exhibited greater disruption of sleep continuity, decreased REM sleep time and activity, decreased amounts of NREM Stages three and four sleep, frequent daytime naps with nighttime periods of wakefulness, and diminished delta activity (Fineberg, Koresko, & Heller, 1967; Prinz et al., 1982a). Some investigators reported that sleep measures in mildly demented Alzheimer's patients were minimally affected, but REM time and REM activity/density were significantly affected in later stages of dementia (Vitiello et al., 1984). Concurrent with advancing dementia, Alzheimer's patients show a gradual but progressive loss of phasic activity, both of rapid eye movements in dream sleep and of spindles and K-complexes in NREM sleep. In addition, the amount of slow-wave sleep and the number of delta waves diminish in dementia (Reynolds et al., 1985c). Finally, Alzheimer's patients have significantly more sleep-

disordered breathing than elderly controls or depressives (Ancoli-Israel et al., 1985; Billiard, Touchen, & Passarant, 1980; Frommlet et al., 1986; Hoch et al., 1986; Reynolds et al., 1985a; Smirne et al., 1981). These sleep variables have been explored as potential biological markers for Alzheimer's disease. However, definitive markers in early or mild dementia have not been isolated yet.

Sleep Disturbances and Aging. Several sleep disturbances of considerable epidemiological and clinical interest have been studied in relation to advancing age including sleep-disordered breathing, nocturnal myoclonus, excessive daytime sleepiness, and insomnia. Each disturbance can be the result of pathology or may precipitate other significant sequelae among older adults.

Sleep-disordered breathing and its relation to advancing age is determined by nocturnal polysomnographic recordings. Sleep apnea occurs when there are at least five apneas (complete cessations of respiration) or hypopneas (partial cessation of respiration) per hour of sleep, with each event lasting a minimum of ten seconds. The apnea index (AI) is the number of apneas per hour of sleep; apnea-hypopnea index (AHI) is the number of apneas and hypopneas per hour of sleep. Apneic events are usually followed by an awakening or arousal and can be associated with many symptoms including decreased blood oxygen levels, cardiac arrhythmias, nocturnal hypertension, nighttime confusion, and neuropsychiatric impairment. Numerous studies have directly or indirectly examined the prevalence of sleep-disordered breathing (apneas, hypopneas, and oxygen desaturations) in healthy aging populations and in randomly selected community resident elders. Results consistently demonstrate age-related increases in the prevalence of sleep-disordered breathing (Ancoli-Israel, Kripke, Mason, & Kaplan, 1985; Ancoli-Israel, Kripke, Mason, & Messin, 1981; Bixler et al., 1985; Carskadon & Dement, 1981b; Kripke & Ancoli-Israel, 1983). Estimates of AI and/or AHI of five or greater have been reported in one-fourth to one-third of older persons studied (Ancoli-Israel, 1989; Berry & Phillips, 1988; Hoch et al., 1986; Mosko et al., 1988; Reynolds et al., 1985b). Gender differences also have been noted with increased prevalence of sleep apnea in elderly men versus elderly women (Ancoli-Israel, 1989; Hoch et al., 1986; Mosko et al., 1988; Reynolds et al., 1985b; Williams, Karacan, & Hursch, 1974). However, the significance of the condition is not clear.

In studies with more medically and neuropsychiatrically compromised elders, the impact of sleep-disordered breathing may be differentially greater. Higher rates of sleep apneas have been found among nursing home residents and medical ward patients than in independently-living elderly (Ancoli-Israel & Kripke, 1986). The higher rates of sleep apnea in randomly selected elderly medical ward patients were attributed to congestive heart failure (Ancoli-Israel, 1989). Other studies have reported significant associations between sleep-disordered breathing and substantial cardiovascular morbidity (Guilleminault, 1983; Guilleminault, et al., 1984; Guilleminault, Connolly, & Winkle, 1987; Guilleminault, Van den Hoed, & Mitler, 1978; Kales et al., 1984; Lavie, Rachamin, & Rubin, 1984). Numerous investigators have examined cognitive impairment in patients with and without sleep apnea (Ancoli-Israel et al., 1985; Billiard, Touchen, & Passarant, 1980; Smallwood et al., 1973; Frommlet et al., 1986; Hoch et al., 1986; Reynolds et al., 1985a; Smirne et al., 1981). All except one (Smallwood et al., 1973) found a relationship between hypoxemia (caused by sleep apnea) and mental deterioration. In addition, impaired respiration has been linked to mortality (Kripke et al., 1986; Kripke & Ancoli-Israel, 1983; Kripke, Ancoli-Israel, Mason, & Messin, 1983). With respect to sleep-disordered breathing in elderly patients with neuropsychiatric impairment, the rate in elderly depressives does not appear to be significantly greater than that of age- and sex-matched controls. Studies have reported a 16 to 18 percent occurrence of sleep apnea in elderly depressives compared with four to six percent in healthy elders (Hoch et al., 1986; Reynolds et al., 1985a). However, a significantly higher prevalence of sleep-disordered breathing has been found in elderly patients with probable Alzheimer's disease than in age- and sex-matched controls by some (Ancoli-Israel et al., 1985; Billiard, Touchen, & Passarant, 1980; Frommlet et al., 1986; Hoch et al., 1986; Reynolds et al., 1985a; Smirne et al.,

1981) but not all investigators (Smallwood et al., 1973). A few investigators also have examined the functional significance of sleep-disordered breathing in Alzheimer's disease. Severity of dementia has been correlated significantly with percent of indeterminate NREM sleep and severity of sleep apnea (Hoch et al., 1986; Reynolds et al., 1985a). Data also suggest that sleep-disordered breathing in nonmedicated Alzheimer's patients is relatively mild and is not a predictor of overnight changes in respiration, nocturnal oxyhemoglobin desaturation, overnight mental status, or nocturnal behavior (Hoch et al., 1989). Finally, in elderly patients with mixed symptoms of depression and cognitive impairment who had died by 2-year followup, apnea-hypopnea indices (and REM latency) correctly predicted 77 percent of survivors (Hoch et al., 1989).

Nocturnal myoclonus or periodic leg movement in sleep is a sleep disturbance in which people kick or jerk their legs every 20 to 40 seconds periodically throughout the night. It is measured by polysomnographic recordings of anterior tibalis muscle activity. Myoclonus index (MI) is calculated as the ratio of periodic leg movements associated with arousals to total sleep time in hours. Research has generally focused on prevalence rates. Few studies of nocturnal myoclonus have been reported specifically with regard to older adults. Among elderly with sleep complaints, the rates of nocturnal myoclonus range from four to 31 percent (Okerdaira et al., 1983; Reynolds et al., 1980). However, in studies with healthy elderly people, rates range from 25 to 60 percent (Dickel, Sassin, & Mosko, 1986; Okerdaira et al., 1983). Some investigators also have studied myoclonus in Alzheimer's patients but did not find associations between leg movements and diagnosis (Ancoli-Israel et al., 1986).

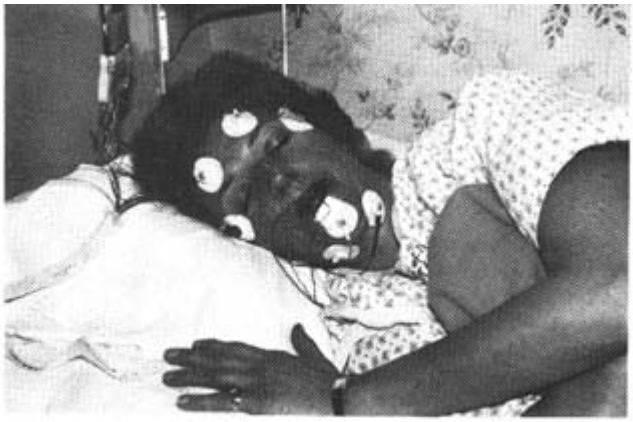
When nighttime sleep is reduced or disturbed, the result is increased sleepiness the next day. Excessive daytime sleepiness in older people may be indicative of an underlying sleep problem that results in a deterioration of the continuity of nocturnal sleep. Daytime sleepiness is measured objectively by the multiple sleep latency test (MSLT) using polysomnography during four or five daytime naps lasting 20 minutes. The MSLT measures how long it takes an individual to fall asleep during the daytime when given multiple opportunities to do so. Research has demonstrated that older adults consistently fall asleep in less than 15 minutes, more quickly than other age groups (Richardson et al., 1978). When elders are asked to subjectively describe their sleep and daytime functioning, most report that their sleep is satisfactory, yet they also report daytime sleepiness (Ancoli-Israel, Kripke & Mason, 1984). Investigations have shown also that older adults take more naps than younger people (Carskadon, Brown, & Dement, 1982; Tune, 1968; Webb & Swinburne, 1971). MSLT data, in conjunction with nocturnal sleep studies, would be useful to determine the extent and severity of daytime sleepiness and to explore relationships with the nocturnal sleep of elders.

Studies suggest that older adults are the age group most affected by disorders of initiating and maintaining sleep (Carskadon & Dement, 1981a; Dement, Miles, & Carskadon, 1982; Miles & Dement, 1980a). Insomnia refers to the perception of an individual that his/her sleep is inadequate or abnormal. Symptoms generally include both nocturnal symptoms (difficulty initiating sleep, frequent awakenings from sleep, short sleep time, "nonrestorative" sleep), and daytime symptoms (fatigue, sleepiness, depression, anxiety, other mood changes) that result from poor nighttime sleep. These symptoms are similar to those complaints most frequently offered by elders about their sleep: spending more time in bed; taking longer to fall asleep; awakening more often; being sleepy in the daytime; and needing longer to adjust to changes in the usual sleep-wake schedule. For transient insomnia among older persons, which lasts for three to four weeks and results from situational causes, medication is generally acceptable treatment. However, for prolonged or chronic geriatric insomnia, nonpharmacologic interventions are warranted. Improving sleep hygiene by promoting a safe and comfortable sleep environment, setting a regular time to go to bed, exercising, and avoiding alcohol and caffeine is essential. Overreliance on the use of over-the-counter drugs to treat symptoms of sleep disorders can be ineffective and make conditions worse. In addition, many cause side effects such as blurred vision, dry mouth, and drowsiness.

Research protocols for geriatric insomnia, using sleep restriction and relaxation training methods, have had only limited success (Bliwise, Friedman, & Yesavage, 1988).

Sleep Problems in the Nursing Home. Disturbed sleep with nighttime wandering is one of the most frequent reasons why elderly individuals are institutionalized (Pollak & Perlick, 1987; Sanford, 1985). Sleep disturbances and related behaviors and complaints are common among nursing home populations. Studies have estimated that 35 percent of nursing home residents receive tranquilizing medications (James, 1985; U.S. Public Health Service, 1976). Observation, interview, and questionnaire measures are the most frequent methodologies used in studies of sleep in nursing home settings. Sleep patterns around the clock have been observed with increasing amounts of sleep in a 24-hour period usually resulting from increased daytime sleep rather than an increase in nocturnal sleep (Regestein & Morris, 1987). Investigations also have demonstrated great individual variability in sleep patterns of nursing home patients (Bliwise et al., 1987; Jacobs et al., 1989). Objectively recorded sleep by portable nocturnal polysomnography was used in a randomly selected group of elderly nursing home patients (Jacobs, et al., 1989). These patients averaged only 39.5 minutes of sleep per hour in any hour of the night, and 50 percent woke up at least two times per hour. When a subgroup of these nursing home residents were recorded for a full 24 hours, patients spent some portion of every hour asleep. In addition, their sleep was so fragmented that they rarely experienced even a single hour of consolidated sleep (Ancoli-Israel, Parker et al., 1989). As previously described, sleep-disordered breathing is also more prevalent among nursing home residents than community-residing elders (Ancoli-Israel & Kripke, 1986).

Mortality. Mortality rates at various times during the night have been studied. Mortality rates from all causes are estimated to increase 30 percent during sleep (Smolensky, Halberg, & Sargent, 1972). Excessive death between 2:00 a.m. and 8:00 a.m. has been found, with the peak being relatively specific to ischemic heart disease in persons over the age of 65 years (Mitler, et al., 1987). Studies have shown that people who report either sleeping less than seven hours or more than eight hours have a higher mortality rate, with 86 percent of these deaths among individuals over 60 years of age (Belloc, 1973; Kripke et al., 1979). It has been hypothesized that sleep apnea may be one cause of increased mor-tality (Bliwise et al., 1987; Hoch et al., 1989; Kripke & Ancoli-Israel, 1983; Kripke et al., 1986).



Courtesy, Center for Women's Health Research, School of Nursing, University of Washington, Seattle, WA

Research Needs and Opportunities

Nursing research studies on sleep and older persons present a challenge for the next decade. The majority of sleep and aging research studies that have been conducted have not been designed by nurses. Nursing research studies on sleep and older adults have focused primarily on observational

and subjective methodologies, such as sleep patterns among institutionalized elders (Caplin-French, 1986; Gress, Bahr, & Hassahein, 1981) or sleep behaviors and routines (Colling, 1983; Hayter, 1983). Colling (1983), in a theoretical and empirical analysis of sleep disturbance patterns in aging, concluded that more research is needed to delineate specific assessment parameters and intervention techniques. We have yet to meet this goal. In addition, it is essential that nurses acquire greater biotechnological knowledge and skill in objective sleep measurement to facilitate the design and implementation of sophisticated nursing research studies on sleep and older persons that can address complex biopsychosocial hypotheses about sleep in both healthy and ill elders, thus providing data that have relevance for all disciplines that care for and about older people.

Several research areas must be addressed with regard to sleep in healthy older adults. Because assessment of sleep is gen-erally done with subjec-tive data, it is imperative that a self-report or interview-admin-istered instrument be developed that both accurately assesses sleep parameters and is validated by polysomnography. In addition, empirically-based sleep hygiene measures have to be developed and tested. Currently, elderly individuals are taught how to improve their sleep without the benefit of tested interventions. Although MSLT has been used with clinical populations of elderly, normative data about daytime sleepiness has not been established. Such information could enhance our understanding of nocturnal sleep changes associated with aging and their effects as well as provide a rationale for sleep hygiene interventions.

The sleep of depressed older persons has been well characterized by objective and subjective measures. It has yet to be determined, however, if these sleep markers occur with other mood-altering events such as retirement or bereavement. The intensity of such events can be measured using sleep parameters as well as other clinical instruments to develop models that characterize elders who become depressed in conjunction with mood-altering events.

Further exploration of sleep-disorder breathing in Alzheimer's disease and other dementias is warranted. This is a significant problem that may be related to disrupted nocturnal behaviors and overnight mental status changes. Once a firm knowledge base is established through research, intervention studies for sleep apnea should be developed for demented elders. The potential for keeping the dementia victim out of the institution will be reflected in decreased health care costs and may improve quality-of-life for patients and their significant others.

Because the use of prescribed and over-the-counter drugs is significantly increased in older persons (who are already at risk for sleep apnea), controlled studies of the effects of various medications on nocturnal respiratory function should be conducted. Studies could be conceptualized with chronically-ill older persons (medical as well as neuropsychiatric) in both acute-care settings and long-term care institutions. Careful attention should be directed toward changes in baseline respiratory function (such as oxygen desaturation) at selected intervals following medication administration. Perhaps links to disturbing behaviors, declining cognitive function, sleep fragmentation, and mortality will emerge. Interactions among sleep physiology, nocturnal respiration, illness, and medication must be explored. From this data, effective intervention protocols can be developed and tested.

Perhaps the elders most in need of sleep interventions are those in nursing homes who are at higher risk for sleep disturbances, sleep-disorder breathing, and mortality during sleep. Severe sleep fragmentation and disturbed sleep need examination. Biological, psychological, and environmental factors related to sleep disturbances and to disruptive nocturnal behaviors need characterization. Sleep intervention protocols that facilitate sleep consolidation such as sleep restriction or changing environmental routines should be developed and tested. These recommendations are in keeping with a recent NIH Consensus Development Conference that urged more research, education, and public awareness of sleep disorders in older persons. Research was recommended in the following areas: 1) classification and diagnostic criteria; 2)

identi-fication of appropriate animal models for studies on the basic mechanisms of sleep changes in aging; 3) identification of biological markers; 4) examination of the natural history of sleep disorders; 5) study of the disruption of normal circadian rhythms by dislocation (e.g., moving to a nursing home); and 6) examination of the benefits of treating these disorders.

Recommendations

Based on the foregoing assessment of research needs and opportunities in "Sleep and older persons," the Panel has made the following recommendations for research.

- Develop self-report or interview instruments to accurately assess sleep parameters in older persons.
- Establish normative data on daytime sleepiness in older persons.
- Determine the impact of mood-altering events on sleep in older persons (e.g., retirement, bereavement).
- Examine sleep-disordered breathing in Alzheimer's disease and other dementias.
- Conduct controlled studies on the effects of medications on nocturnal respiratory function in older persons.
- Test sleep interventions in the institutionalized elders.

Glossary of Terms

Sleep Variables

- **Sleep Continuity Measures**

  Total Recording Measures: Total number of minutes from initial plug-in to the end of the recording.

  Sleep Latency: Time from lights out until the appearance of 10 minutes of Stage 2 sleep interrupted by no more than 2 minutes of awake or Stage 1.

  Awake: Time spent awake after sleep onset and before the end of the recording period.

  Time Spent Asleep: Time spent asleep after sleep onset, less any awake during the night.

  Arousal: Period of wakefulness lasting 30 seconds or longer.

  Sleep Efficiency: Ratio of time spent asleep to total recording period.

  Sleep Maintenance: Ratio of time spent asleep to total recording period after sleep onset.

- **Sleep Architecture**

  Stage 1: NREM sleep with low voltage activity waves three to seven cycles per second; a transition between wakefulness and sleep.

  Stage 2: NREM sleep marked by the appearance of sleep spindles and/or K-complexes.

  Stage 3: NREM sleep with delta waves occupying 20 to 50 percent of EEG activity.

  Stage 4: Deepest NREM sleep, with delta waves occupying more than 50 percent of EEG

activity.

- **REM Sleep Measures**

  REM Latency: Number of minutes of sleep onset until the first REM period.

  REM Time: Total number of minutes of REM sleep.

  REM Activity: Each minute of REM sleep is scored on a nine-point scale (0-8) for number of rapid eye movements; REM activity is the sum for the whole night.

  REM Density: Ratio of total REM activity to total REM time.

  REM Intensity: Ratio of REM activity to time spent asleep.

  REM Period: Occurrence of at least three consecutive minutes of REM sleep separated from the next occurrence of REM sleep by no less than 20 minutes NREM sleep.

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