Psychiatric research in recent years has focused more and more on the biological etiology of mental illness. One intense area of research has been that of biological rhythms. Disturbances in normal biological rhythms are seen in affective illness as evidenced by disruptions of sleep patterns, diurnal variation in mood, and seasonal patterns of recurrence. Psychiatric nurses can add an additional tool to their repertoire by understanding the mechanisms that control sleeping and waking, how those mechanisms become disrupted and readapted, and how they relate to affective illness.

Biological Rhythms

Biological rhythms are cyclical variations in physiologic and biochemical functioning, level of activity, and emotional state. All of life is replete with these rhythms, which is evidenced throughout nature in the ebb and flow of the tides, the alternations of light and dark as the earth rotates, and the sleeping and waking cycle of living creatures. All of the living functions of human beings occur in cycles, from the macro-function of the whole person, down through organ systems, to the micro-functions of cells. These rhythms can be classified as circadian, ultradian, or infradian. Circadian (from the Latin, *circa*, about, and *dies*, a day) rhythms occur in approximately 24-hour cycles, ultradian cycles are those less than 24 hours, and infradian cycles are those more than 24 hours.

Each system, parameter, or cell has its own rhythm. In order for the substance or process to arrive at the right place at the right time in the right quantity, each rhythm is synchronized with the other internal rhythms and with the external environment. Cyclic sequencing of hormones and neurotransmitters allows incompatible combinations of substances to appear at different times, thereby maximizing their effects when needed. Desynchronization of rhythms may result in appearance of incompatible substances or processes at the same place and at the same time (Corfman, 1979). Biological rhythms are synchronized to either internal or external events or a combination of both.

A rhythm synchronized to external events is termed exogenous, while one synchronized to internal events is termed endogenous.

All of these rhythms are synchronized by a biological clock or clocks within each organism (Kripke, 1978). These clocks serve as a master control over the other rhythms. Each rhythm, however, has its own control. Most circadian rhythms have an endogenous pacemaker that runs slightly longer than 24 hours. Subjects who have been isolated in caves or laboratories without time cues exhibit continued rhythm periodicity of an average of about 25 hours (Aschoff, 1981). It appears that endogenous rhythms are coupled or entrained to external cues to adapt to the 24-hour cycle. Some systems are entrained to the
light-dark cycle, some to the sleep cycle, and some to meals or activity. The most influential external synchronizer in man is thought to be his social cues (Kleitman, 1963). The great influence of the light-dark cycle in man has been emphasized by more recent research (Winfrey, 1982).

There appear to be two major clock systems within the rhythm system. One is a very strong system that resists change and keeps its cycles recurring about every 25 hours. The second, weaker system controls waking and sleeping and may be altered more quickly. These two clocks are thought to be arranged hierarchically. The weak system adapts first to the external environment and the stronger system then slowly synchronizes with the weaker one.

Regularity in timing of eating, sleeping, and working results in synchronization of all body rhythms. Changes in these activities require responsive changes in the corresponding body rhythms. Some rhythms adjust rapidly to changes in waking-sleeping time while others require more time to adapt. Some rhythms are extremely resistant to change. A shift in waking and sleeping time of eight to 12 hours—as occurs when changing working times from day shift to night shift—may alter biological rhythm synchronization with resulting adaptation taking one to two weeks or longer.

Hoskins (1981) suggests a rule of thumb for adjustment of one day for each hour of time shift. For example, body temperature and plasma cortisol levels stubbornly resist change and may take weeks or months to completely adapt, while growth hormone release is timed with stage three and four sleep whenever it occurs. This difference in adjustment time results in desynchronization of various body rhythms. While adaptation and resynchronization are taking place, the body is in a state of desynchronization between itself and the environment, and the rhythms within the body are desynchronized with each other. Persons who are desynchronized and in the process of adaptation report dysphoria, difficulty sleeping, and various physical complaints. It is likely that the well-being of man depends partly on the maintenance of the order of the chronobiological system.

One well-known example is the dysphoria, or “jet-lag,” experienced after jet travel over several time zones. The shortening or lengthening of the day of the traveler changes eating, sleeping, and activity times. The internal order is still responding to old schedules resulting in desynchronization of various rhythms. Disruptions of schedules, shift work, and the shift to daylight savings time all result in at least some disruption in the rhythm system. Stress also alters the system (Kripke). Drugs that either depress or stimulate the central nervous system may disrupt the synchronization of the system. For example, alcohol and the sedative drugs alter the normal structure and pattern of sleep.

Affective Illness

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then the normal range of adaptation includes day lengths of 25 to 27 hours, a two-hour variation either way from 25 hours. Going to bed one hour earlier than usual (a 23-hour day), for an individual with a 25-hour circadian cycle, requires a two-hour adaptation. Going to bed three hours later is still only a two-hour adaptation (a 27-hour day). This is why it is easier to stay up later and sleep later than it is to go to bed early and get to sleep. This phenomenon also will be evidenced in jet travel. It is much easier to travel from east to west than vice versa.

Older persons have much more difficulty adapting to changes in schedule. This may be related to the fact that there is much less variation in a rhythm over the course of a day as an individual ages. For example, temperature changes for a normal, young adult average about 1° Centigrade over 24 hours. This variation diminishes with age. Temperature does not increase as much during wakefulness nor decrease as much during sleep, and it is linked with decreased daytime activity and more nighttime wakefulness.

Rhythm and Structure of Sleep
Shifting the sleep time alters the structure of sleep. Electroencephalograms (EEGs) taken while a person is sleeping reveal a consistent pattern of changes, as shown in Figure 1. This pattern recurs about every 90 to 100 minutes with predictable alterations (Hayter, 1980). Distinct EEG patterns are named stages; four separate stages are distinguished. EEG recordings are reflections of electrical waves. These are described by frequency and amplitude. Frequency refers to how tightly scrawled the tracings are and reflects the rapidity of impulses while amplitude is the vertical height of tracings and reflects the amount of energy discharged at each impulse.

EEG tracings of Stage I sleep are virtually the same as those of drowsy wakefulness and are very rapid low amplitude tracings. During Stage II, the amplitude increases somewhat and little bursts of energy appear.
Stages III and IV are characterized by increasing amplitude and lowered frequency. Rapid eye movement sleep (REM) occurs at the end of a sleep cycle, after the sleeper descends through all four stages and back to Stage I. EEG tracings of REM sleep look the same as Stage I sleep. Even though the person is sleeping soundly, he will not awaken, but his eyes will begin darting as if tracking some action beneath the closed lids; visual portions of the brain will emit volleys of signals in short bursts. Breathing and pulse become irregular, muscles flaccid. If awakened, “he almost always recalls dreaming” (Luce, 1971).

Upon drifting off to sleep, the sleeper descends from Stage I to Stage IV and back to Stage I REM regularly during the night. In a normal night’s sleep, this 90 to 100 minute cycle will be repeated about four to five times (Figure 2). The duration of time spent in the various stages will vary predictably as the night progresses. In the first portion of the sleep period, most of the time is spent in Stages III and IV, and REM sleep periods are extremely brief. As the night progresses, REM periods become longer and longer and Stages III and IV may disappear. By morning, sleep may alternate between Stage II and REM sleep. This pattern of sleep structure appears to be necessary for healthy physical and mental functioning of the human being. It helps the system deliver important hormones and processes in the proper sequence. For example, growth hormone is released only during Stages III and IV sleep, while cell division occurs during REM sleep. Since Stages III and IV sleep occur before the REM sleep, the growth hormone has been circulating to facilitate cell growth. Memory may also be stored during this time.

The biological clock system helps to keep this structure of predictable sleep stage cycles in place. Stages III and IV are synchronized directly to sleep time. The length of these stages related directly to the length of time of the prior period of wakefulness. The length of the entire sleep period is dependent upon one’s circadian rhythm (Czeisler, 1980). Alterations in bedtime may either shorten or lengthen the time spent asleep, depending upon the individual person’s normal circadian rhythm. REM sleep also follows a circadian rhythm. It is most likely to occur in the morning hours, with noon the peak period no matter when sleep began, and least likely to occur around midnight (Winfree, 1982). Therefore, changing sleeping flexibility in bedtimes on a nursing unit may assist patients in gaining a better night’s sleep.

Flexibility in bedtimes on a nursing unit may assist patients in gaining a better night’s sleep.

Biological Rhythm and Affective Illness

Depression

Weitzman, Kripke, Goldmacher, et al pointed out the similarities between the sleep of normal subjects who have shifted their sleep time and those people suffering from endogenous depression. REM sleep occurs earlier and the total pattern indicates more frequent stage shifts and a tendency to awaken earlier. They raised the question as to whether some of the physiological changes of the endogenously depressed might be due to a disturbed, phase-shifted circadian cycle.

There are several indications of biological rhythm disturbances in depression. Complaints of those known to be in a state of desynchronization reflect commonly heard complaints of the depressed. They commonly complain of nervousness, are irritable, and have multiple

somatic complaints. Goodwin, Wirz-Justice, and Wehr (1982) pointed out four clinical features of depression that appear to indicate circadian rhythm disturbances:
- Early morning awakening;
- Diurnal variation in symptom severity;
- Seasonality;
- Cyclicity of the illness.

Wehr, Wirz-Justice, Goodwin, et al (1979) twice were able to bring a manic-depressive woman out of the depressed state for two weeks by advancing the time of sleep and the time of awakening by six hours. Vogel, Vogel, McAbee, et al (1980) reported improvement of depression by correcting one aspect of the rhythm disturbance, awakening subjects to deprive them of REM sleep.

A study of travelers who were admitted to a psychiatric hospital from London's Heathrow Airport produced interesting findings (Juhaer, 1982). Affective illness was related to time zone change. Depression was diagnosed significantly more often on flights from east to west, while hypomania was found more often in travelers going from west to east. Flights requiring a delay in sleep and wake times seemingly triggered depressive episodes, while those requiring an advance triggered hypomania.

Goodwin et al and Wirz-Justice et al provided evidence that antidepressant drugs work by suppressing REM sleep and lengthening the period of the biological rhythm. They hypothesized that depression occurs in susceptible persons when a sleep-sensitive phase of the circadian system becomes advanced from the first hours of waking into the last hours of sleep and interacts with sleep to cause depression. They also explained the delay in action of the antidepressants as the length of time it takes to sufficiently lengthen the circadian cycle to improve the depression.

Manic Depressive Illness

Bipolar affective disorder has been correlated with circadian rhythm irregularities for some time. Wehr and Goodwin (1981) described two autonomous circadian clock systems: a strong and stable one inferred from the spontaneous fluctuation of core temperature and the corresponding modulation of sleep durations; and a weaker, more labile system that plays a more conspicuous role in tossing us back and forth between sleep and waking.

Bipolar circular manic-depressive cycles may result from the weaker sleep-wake cycle uncoupling from the other cycle, resulting in a free-running condition. These two cycles, running at different rates, would at some point relate to each other in phase (in the synchronized position) and at other times result in total opposition. The end effect results in a 48-hour day at the onset of a manic episode. Lithium appears to lengthen the shortened cycle facilitating the recoupling of the two systems. They also found lithium did not help those patients with longer than normal circadian cycles.

Biological Rhythms and Nursing Care

Knowledge of the biological rhythm system is an added tool for psychiatric nurses to assist their clients. Disordered sleep in hospitalized psychiatric patients is more the rule than the exception, particularly for severely depressed patients. It is not uncommon that their failure to sleep well at night prompts patients to attempt to nap during daytime hours. Depressed persons experience less Stages III and IV sleep than others anyway, and since these stages are dependent on the period of wakefulness, napping may actually exacerbate this problem. Many seriously depressed persons feel better in the evening and dread trying to sleep. They may stay awake past midnight and report excessive dreaming and fitful sleep. Assisting depressed patients to move their sleep time earlier in the evening may possibly be helpful. Even though it may be inconvenient for nursing staff, allowing depressed patients who awaken at 5:00 a.m. to get up, dress, and engage in some quiet activity may help them to feel better.

Several facts about the sleep structure are important for nurses to bear in mind. People are able to adjust to changes in sleep and wake times within a limited range. It is easy to go to bed one-hour earlier to two hours later, but greater changes will disrupt sleep. Flexibility in bedtimes on a nursing unit may assist patients in gaining a better night's sleep. Those patients who normally go to bed at midnight will have great difficulty getting to sleep at 10:00 p.m. Those who normally retire early, but stay up very late in the hospital, will usually awaken at their normal time feeling tired or doze fitfully while trying to rest more. Therefore, in attempting to help a patient shift his or her sleeping time, these limits need to be considered.

It is common for nurses to encounter patients who report "not sleeping a wink" when that patient was observed during rounds lying quietly with eyes closed and breathing deeply and rhythmically, with all the external signs of being asleep. The patient's subjective report may be discounted, since it is contrary to the nurse's observation. A more likely explanation is that even though the patient slept, the normal structure was altered enough that they did not feel rested and may have awakened frequently as well.

A thorough sleep assessment is important. Important items to determine include:
- When is the patient's normal bedtime?
- Does the patient follow this time regularly?
- Is the time the patient has given usual only during the development of decompensation, or is it the long-term pattern?
- What time does the patient find it easiest to fall asleep?
- How long will the patient then sleep if in a quiet, darkened, cool room?
- When does the patient usually awaken?
- When does the patient usually feel the most active?
- If given a choice to go to bed any-
time, when would the patient choose?

- Would the patient be able to fall asleep then?

Questions such as these help to ascertain the circadian pattern of sleep for an individual. Are they responding to their body or not? This assessment can form a basis for the nurse to work with the patient to improve the quality of sleep.

It is not known whether affective illness is a dysfunction of the circadian system or if the dysfunction is another of the changes that occur in the course of the illness. It is known that certain factors do disrupt the circadian system and the synchronization of the various rhythms. One of the most noticeable and subjectively problematic changes is sleep structure changes. Since stress induces alterations in circadian rhythms, it follows that stress reduction measures possibly may assist both patients and nurses to sleep more normally.

Loss of sleep is distressing, but some measures used to induce sleep are counterproductive. Alcohol induces sleep, but it destroys the normal pattern of sleep structure and sleep stages become erratic. Virtually all drugs used to induce sleep alter sleep structure to some degree. However, sleep inducing medication does seem to be necessary for some patients. There are a number of things nurses can do to assist patients to sleep more normally. For some people, eating regularly, staying active during waking hours, and cutting back on caffeine—especially late in the day—may be sufficient for more normal sleep without medication.

For the manic patient, teaching the importance of regularity in eating, sleeping, and activity may be important, especially in prevention of manic episodes. If a manic episode is precipitated by out of synchronized biological systems, any measure that helps synchronize those systems will be beneficial. Shiftwork might accelerate desynchronization as might alcohol and drug use. Teaching relaxation and stress reduction measures should help. Exposure to bright sunlight seems to help synchronize systems, so sunbathing and outdoor activities also may have a beneficial effect.

Extensive research and expansion of knowledge about the rhythmic nature of physical and mental activity of human beings has shed new light on affective illness. One of the most prominent features of these illnesses is sleep disturbance. Understanding the dynamics of the sleep disturbances can help the nurse to intervene with psychiatric patients.

**References**


Wirz-Justice, A., Campbell, I.C. Antidepressant drugs can slow or dissociate circadian rhythms. Experientia 1982; 38:1301-1309.

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**Biological Rhythms**

**KEY POINTS**

**Biological Rhythms and Affective Illness. Plumlee, A.A. Journal of Psychosocial Nursing and Mental Health Services 1986; 24(3):12-17.**

1. Biological rhythms are cyclical variations in physiologic and biochemical functioning, level of activity, and emotional state.

2. Sleep has biological rhythms, both when it occurs and in the rhythmic brain changes that occur during sleep. A predictable pattern of cycles of brain activity during sleep appears to be necessary for healthy physical and mental functioning of the human being.

3. Persons suffering from affective illness complain of symptoms common to those who have experienced desynchronization of biological rhythms due to jet lag or working night shifts. Characteristic changes in sleep cycles also occur.

4. Understanding the dynamics of sleep disturbances can help the nurse to intervene with psychiatric patients.