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# PSYCHIATRIC ASPECTS OF SHIFTWORK

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Not to be abed after midnight is to be up betimes.
Shakespeare, *Twelfth Night*

In the opening scene of *Hamlet*, two guards meet in darkness at midnight on a castle wall. Oddly, it is the approaching guard, come to start his shift, who issues the challenge, "Who's there?" This seems irregular. Has the on-duty guard been sleeping, or is the relief guard acting inappropriately owing to sleep deprivation or disturbed circadian rhythms?

Are mental dysfunctions caused by shiftwork?

Shiftwork produces serious disruption of the circadian system,[5,17,43,71] as well as social isolation and various other stressors.[40,41,53,66] Both circadian disturbances[68] and psychosocial stress are thought to contribute to psychiatric illness. Does working shifts therefore increase a person's risk of developing psychiatric disturbances?

What follows is a critical review of the relationship of shiftwork to psychiatric morbidity, the possible mechanisms by which shiftwork might contribute to psychiatric disturbances, and a note on the potential of artificial bright light to reduce psychiatric shiftwork problems.

## METHODOLOGICAL COMMENT

A major methodological difficulty in studying effects of shiftwork on psychiatric (or medical) morbidity is that shiftworkers are a self-selected group. For example, Meers et al.[37] found that of 104 new shiftworkers who entered

employment at a wire mill, 40 (38%) dropped out within four years. Many shiftworkers transfer to daywork for health reasons or because of psychological difficulties.[8,18,19] Thus, cross-sectional or retrospective studies of shiftworkers could be misleading. If shiftwork causes psychiatric problems and some people drop out because of them, a study that focuses only on "survivors" who continue to work shifts might overlook the people who are most adversely affected. On the other hand, if we study shiftwork dropouts and find an increased incidence of psychiatric morbidity, how can we distinguish whether this morbidity was caused by working shifts or whether the psychiatric problems developed independently?

Other factors complicate the picture still further. Some shiftwork settings involve reduced social demands that might attract psychiatrically compromised workers. Some supervisors might find it easier to assign workers with psychiatric difficulties to nightshifts than to deal with them on dayshifts. Clearly, either longitudinal studies of new shiftworkers or randomizing studies to separate cause and effect are needed in this area. Unfortunately, to our knowledge, no sufficiently well-controlled studies exist to determine if shiftwork *causes* psychiatric difficulties. Available data are at best a basis for speculation.

## SHIFTWORK AND PSYCHIATRIC MORBIDITIES

### Psychiatric Hospitalization

Koller et al.[28] interviewed all patients admitted to an Austrian psychiatric hospital over four months. The proportion of psychiatric patients who were working shifts or irregular hours prior to admission was higher than would be expected in the general population. However, this difference reached statistical significance only for occasional nightworkers, not for permanent ones. This study suggested that shiftworkers might be at increased risk for psychiatric hospitalization, but it did not show whether work schedules cause psychiatric problems.

One mechanism by which shiftwork could theoretically induce psychiatric disturbances is by disrupting circadian rhythms. Jet travel across time zones causes circadian disruption similar to that caused by shiftwork.[20] Jauhar and Weller[26] retrospectively studied all admissions to a psychiatric hospital near London's Heathrow Airport over a 2-year period. Compared to the hospital's entire catchment area, the airport accounted for a disproportionate number of admissions for schizophrenia. Because a large proportion of airport patients had just flown across time zones, this finding is consistent with a hypothesis that rhythm disruption might precipitate psychiatric episodes serious enough to require hospitalization; however, alternative explanations are possible.

### Substance Use Disorders

Shiftworkers have higher rates of pharmacologic substance use when compared to dayworkers. Based on interviews with 573 male textile workers, Costa et al.[7] reported, "the percentage of those habitually taking drugs was higher among rotating three-shift workers (48%) and permanent nightworkers (28%) than among two-shift (day and evening) workers (12%) and dayworkers (15%): the drugs consumed were mainly hypnotic and sedative (72%)—for sleep and neurotic troubles—and digestive (15%) and analgesic (9%)." In a telephone survey of 3,025 U.S. adults, Gordon et al.[23] found that the rate of self-reported



use of sleep medications among female shiftworkers was more than double that of female nonshiftworkers. Tranquilizer use was also elevated among female shiftworkers. No such relationships were found among males; however, heavy alcohol use was elevated in both male and female shiftworkers. A survey study by Tasto et al.[59] of 1,219 nurses and 1,298 food-processing workers indicated significantly higher rates of consumption of both alcohol and sleep-enhancing medications among rotating shiftworkers than nonrotating day, evening, and nightworkers. Shiftworkers complain of difficulty sleeping during the day,[3] which probably accounts for their increased use of sleeping medications. Their increased use of alcohol and tranquilizers could be due to sleep problems, psychological difficulties, or both.

Tasto et al.[59] also found increased stimulant use in rotating shiftworkers. Because shiftworkers complain that they can't stay awake at night,[5] this is not unexpected. Thelle et al.[64] reported increased cigarette smoking among shiftworkers, but Gordon et al. did not find increased consumption of cigarettes or coffee.[23]

We are aware of no studies assessing the prevalence with which shiftworkers meet DSM III-R criteria for substance use disorder.[9] A caveat applies in this area: "Since denial is a basic defense in drug and alcohol abusers, historical data cannot be assumed to be correct."[46] It would be of interest to determine whether the proportion of shiftworkers among people in treatment for substance use disorders is higher than in the general population.

In advising shiftworkers, it must be emphasized that use of drugs is generally counterproductive. Alcohol can act as a depressant and make it seem easier to fall asleep, but chronic use[22,27] or use to promote daytime sleep[52] produces fragmented sleep with frequent awakenings. For most shiftworkers, sleep disruption is a chronic condition.[3] There is no evidence that prescription hypnotics are effective for long-term use and, in particular, no evidence that they enhance long-term performance.[58]

### Neuroticism

Many studies have described associations between neuroticism and shiftwork. Tasto et al.[59] explored dozens of possible predictors of shiftwork difficulties by administering questionnaires and examining medical records of 1,219 nurses and 1,298 workers in the U.S. food-processing industry. A high neuroticism score on the Eysenck Personality Inventory predicted poor adaptation to shiftwork more strongly than any other variable. Harma et al.[24] assessed factors affecting the shiftwork tolerance of Finnish women. In 128 nurses and nursing aides, they found that neuroticism, measured on the Eysenck scale, was the most powerful predictor of gastrointestinal problems and other symptoms of intolerance to the work schedule. Nachreiner[41] administered the MPI (a German personality inventory) and other survey instruments to 1,005 workers in the chemical industry. Compared to nonneurotics, neurotics reported more dissatisfaction with shiftwork and a greater desire to change to daywork. Based on the responses of former shiftworkers, it appeared that neurotics dropped out of shiftwork sooner than nonneurotics. All of these effects were especially pronounced in introverted subjects.

Costa et al.[7] defined criteria for neurotic disorder as "symptoms of anxiety or depression that required treatment with psychotropic drugs for more than three months or hospitalization." They studied 573 Italian male textile workers and found a 5-fold higher incidence in three-shift workers than in dayworkers

and a 15-fold higher incidence in permanent nightworkers. Aanonsen[1] studied "nervous disorders" among 731 Norwegian shiftworkers and former shiftworkers and 345 dayworkers. "Nervous disorders" were assessed by direct interview and included "slight to serious neuroses," "various degrees of depression," and lasting symptoms for which "no organic cause could be demonstrated." Although no statistical tests were reported, the rate of these disorders was higher among shiftworkers and former shiftworkers (18.6%) than among dayworkers (13.3%).

Two studies found no relationship between neuroticism and shiftwork tolerance. Taylor et al.[61] reviewed institutional records of 965 matched pairs of British shift- and dayworkers in 29 companies. They found no difference in the absence rate of shiftworkers compared to dayworkers when the main cause of absence was classed as "mental and psychoneurotic." However, the validity of retrospective classifications of "psychoneurotic" problems from diverse company records is questionable. Furthermore, the relationship between absence rates and overall shiftwork tolerance is not clear. Mott et al.[40] administered the Cattell 16PF inventory to 1,045 workers in five U.S. plants. The level of neuroticism was unrelated to the level of difficulty workers experienced with their shift schedules. They found, however, that the more the shift schedule conflicted with other life roles, the more problems the worker had. They speculated that it is the situational demands of shiftwork, not underlying neuroticism, that produces difficulties.

All of the data presented so far on shiftwork and neuroticism have been cross-sectional or retrospective and therefore subject to various systematic biases. Meers et al.[37] provided prospective evidence that neurotics adapt poorly to shiftwork. They followed 104 newly enrolled shiftworkers over four years. Individuals who had higher scores on a scale of "psychoneurotic complaints" (as opposed to somatic neurotic complaints) at the time of enrollment were more likely to drop out of shiftwork than those with lower scores for the same complaints.

Lund[35] found a possible physiological basis for the greater difficulty neurotics have with shiftwork. They studied 34 subjects in a temporal isolation unit during "free run." In free run, circadian rhythms are allowed to cycle at their own pace in the absence of external time cues (zeitgebers). Seven subjects experienced internal desynchronization of the core body temperature rhythm from the sleep/wake rhythm. Compared to subjects who did not become internally desynchronized, these seven people had significantly higher scores on a German test of neuroticism, which was administered before the subjects entered the isolation unit. The authors concluded that neurotic people have less stable circadian rhythms than nonneurotics. If this is so, then neurotics might be expected to suffer more pronounced disruption of circadian rhythms than normals when placed in a shiftwork situation.

Lund[36] has also suggested that shiftwork can cause neuroticism. He reported that "in (laboratory) experiments where 'forced internal desynchronization' was achieved by exposing subjects to 30 days of (light-dark) schedules ranging (in period) from 20 to 32 hours, posttrial neuroticism scores were significantly increased." Of course, living in temporal isolation could theoretically increase neuroticism for reasons unrelated to circadian desynchronization. Lund's report did not give enough details of the investigation to determine whether this may have been the case.

In summary, studies from several countries, employing diverse methodologies, converge (with few exceptions) in concluding that neurotics adapt more poorly



to shiftwork than nonneurotics and are more likely to drop out. Preliminary evidence suggests that neurotics may have less stable circadian rhythms than nonneurotics. This might explain their poor adaptation to shiftwork. One study suggested that circadian disturbances such as those produced by shiftwork might induce neuroticism; this possibility deserves further investigation.

In the modern DSM III-R nosology,[9] the general concept of neurotic disorders has been reclassified as mood disorders, anxiety disorders, various personality disorders, and so forth. It is important to reexamine which specific DSM III-R disorders are elevated with shiftwork. Possibly, many of the neurotic complaints described would currently be regarded as symptoms of depression.

## Depression

### PREVALENCE

Few studies have formally assessed depression among shiftworkers. Tasto et al.[59] found elevated depression scores on the Profile of Mood States (POMS) among 309 nurses working rotating shifts, compared to 910 nonrotating day or night nurses. However, they found no elevation of depression among 634 night or rotating food-processing workers. As mentioned above, Costa et al.[7] included depression in their definition of "neurotic disorders" and found a 5- to 15-fold higher rate in shiftworkers than in dayworkers. Similarly, Aanonsen[1] included "various degrees of depression" in his definition of "nervous disorders," and reported a high rate among shiftworkers. Akerstedt and Theorell[4] performed a factor analysis on a self-rating questionnaire administered repeatedly to 17 male railway repair workers. They found that depression was part of a cluster of "sleep/mood" complaints that also included sleep/wake disturbances, apathy, anxiety, fatigue, and restlessness. Sleep/mood complaints increased significantly when the workers were shifted from day to night schedules, then dropped toward baseline upon return to daywork.

Many other studies have found increased psychological and somatic complaints among shiftworkers, including "severe emotional problems," "extreme job stress,"[23] fatigue, apathy, palpitations, nervousness, gastric complaints,[37] "irritation/strain,"[19] muscle pain,[65] reduced subjective well-being,[16] and other symptoms.[2] Some of these complaints could be interpreted as signs of depression. However, since standard psychological inventories were not used, we have no basis for distinguishing symptoms caused by affective disorders from symptoms caused by other psychological problems or by physical ailments related to shiftwork.

Three retrospective studies on shiftwork and depression produced conflicting results. Michel-Briand et al.[38] performed psychiatric interviews on 99 retired shiftworkers and 93 retired dayworkers. Twenty-nine percent of the former shiftworkers were depressed, as compared to 17% of the former dayworkers. Although the two groups were well matched on age and certain other variables, socioeconomic differences between them may have contributed to the results. Koller et al.,[28] studying 188 Austrian patients hospitalized for strictly defined depressive syndromes, found that the proportion who had been employed in shiftwork was no higher than the proportion of shiftworkers in the general population. It should be noted, however, that depressed patients suffering from additional psychiatric disorders or alcoholism were systematically excluded from this study. This could have reduced the number of shiftworkers in the sample.

Taylor and Pocock[60] found no excess mortality due to suicide among shiftworkers or former shiftworkers, compared to dayworkers, in a twelve-year prospective study of 8,603 male manual laborers. Classification as a shiftworker in this study required at least ten years' employment on a shift schedule without any interruption exceeding six months. Thus, the shiftwork group represented "survivors" who tolerated their schedules well enough not to change them over many years. The possibility cannot be ruled out that shiftwork may have induced serious depression in some people who transferred to daywork (or committed suicide) before they were on the job long enough to be included in the shiftwork group.

The evidence regarding shiftwork and depression is incomplete and conflictual. Some of the contradictions might be better understood through considering hypothesized mechanisms by which shiftwork might be related to depression.

### Circadian Mechanisms

Patients with a major depressive disorder experience early onset of REM sleep and early morning awakening, indicating a possible phase advance of one or more circadian oscillators.[29,67] This and other findings have led to the hypothesis that depression may occur when circadian oscillators are phase-advanced relative to environmental zeitgebers.[29] Some shiftwork schedules can place the worker's rest/activity rhythm in a phase-advanced position relative to the environment, and this could theoretically induce depression. A related hypothesis holds that depression might result not from a global phase advance of all oscillators, but rather from the advance of one oscillator relative to another, resulting in an abnormal phase angle between them.[29] If this is correct, then perhaps depression might occur when oscillators are forced out of their normal phase position with respect to one another (e.g., by the introduction of conflicting zeitgebers, as occurs during a nightshift).

Depression is also associated with circadian disturbances other than phase advance and phase angle changes. Major depressives who are free-running may exhibit an abnormally short period of the sleep/wake rhythm.[44] Disturbances of the circadian rhythm of body temperature[67] and cortisol[54] in major depressives have also been reported. A 48-hour sleep/wake rhythm has been reported in some cases of bipolar disorder.[67] Patients with another form of depression, seasonal affective disorder (SAD), appear to have a delayed circadian rhythm of melatonin secretion and tend to sleep late, suggesting delayed circadian phase.[32,33]

The fact that depressed people have disturbed circadian rhythms raises the question of whether disruption of rhythms by external causes, such as shiftwork, can induce or exacerbate depression. Most of the evidence relevant to this question is indirect.

Sleep disturbances similar to those seen in major depression can be induced by forcing normal subjects to adopt an abnormal sleep/wake schedule. For example, Weitzman et al.[70,72] simulated shiftwork in the laboratory by shifting the sleep/wake schedule of normal subjects by 12 hours. This procedure produced short REM latencies, an increase in the amount of REM sleep early in the sleep period, early awakening, and general disruption of sleep. All of these disturbances resemble those seen in depressives during night sleep. Many of them persisted through three weeks on the reversed schedule.[71] Studies of the sleep of actual shiftworkers have shown similar effects.[3,6,30,59]



Thus, disruption of circadian rhythms can produce some symptoms simil to those seen in depression. It is not clear, however, whether rhythm disrupti can produce the disturbances of affect typical of depression.

Free-running in temporal isolation for a sufficient period of time c produce internal desynchronization of rhythms, yet most subjects report r major disturbances of affect when this occurs.[73] On the other hand, some peop have been anecdotally reported to experience severe depression, undetected b the investigators, during internal desynchronization in free-run experiments.[56] In free-run, different rhythms may assume different periods, so that the pha angle between them constantly changes. According to a phase disturban hypothesis of depression, free-run might therefore be expected to produ negative affect at some times but not at others.

Shiftworkers differ from free-running subjects in that they experience a abrupt phase shift of the rest/activity cycle relative to most environment zeitgebers. There is some evidence that phase shifting of zeitgebers can produ disturbances of affect. Rockwell et al.[48] reported a case in which a subje committed suicide two weeks after completing a 27-day laboratory circadia phase-shift protocol. This person showed abnormal phase relationships betwe various rhythms at baseline and, compared to 14 other subjects, experience excessive internal desynchronization and very poor rephasing of many rhythm in response to a 12-hour shift of the light/dark cycle. Although this tragic ca is open to several interpretations, one possibility is that the subject was predispose to depression, and that the disruption of his rhythms induced by the extrem phase shift of the zeitgeber during the experiment triggered a major depressiv episode, which led to his suicide. In an earlier study, Rockwell et al.[47] found tha six subjects living in groups of three in a laboratory isolation unit experience increased depression (as measured by the POMS, the Zung depression scale, an other scales) following an eight-hour phase shift of the light/dark cycle.

Subjects phase-shifted in other laboratory isolation studies have reporte subjective symptoms and behavioral impairments resembling jet lag, but depressio was not measured.[74,75] Jauhar and Weller,[26] in their Heathrow Airport stud found that patients admitted to a psychiatric hospital for depression were signif cantly more likely to have arrived on an east-to-west flight. Because east-to-we flight places a person's circadian rhythms in an advanced phase relative to loc time, these results are consistent with the phase-advance hypothesis of depressio It is interesting to speculate from these data that mania might be exacerbated b forcing a person into a delayed phase. Likewise, one might speculate that seasona affective disorder, in which patients apparently suffer a delayed circadian phas of at least some pacemakers,[32,33] could be exacerbated by west-to-east flight.

We noted earlier that studies of depression among shiftworkers have yielde contradictory results. These contradictions may be due in part to differences i methodology between studies; however, according to the theories we hav discussed, it is also possible that shiftwork itself might have conflicting effects o depression. Wehr et al.[69] reported a case in which a six-hour phase advance o the sleep/wake cycle temporarily alleviated depression. Depending on the wor schedule and the way the worker adapts to it, shiftwork might induce either delay, an advance, or no change in the sleep/wake phase. Thus, according t Wehr's results and the phase-advance hypothesis, shiftwork could theoreticall cause depression, alleviate it, or have no effect at all. Similarly various shiftwor schedules and adaptation strategies could advance or delay circadian rhythm

other than sleep/wake or change the phase angle between different circadian oscillators. Thus, according to phase-angle hypotheses, and depending on the individual's baseline phase angles, shift schedule, and personal predispositions, shiftwork could either exacerbate or ameliorate depression. In addition, several studies have shown that partial or total sleep deprivation can reduce depression.[14,15,21,25] Shiftwork frequently involves sleep deprivation[3] and thus might be prophylactic or therapeutic for some people who are predisposed to depression. Incidentally, in-flight sleep deprivation might also account for some of the jet-lag results discussed above.

### Photic Mechanisms

Seasonal affective disorder deserves special mention with regard to shiftwork. This syndrome is characterized by recurrent depressions that occur annually, especially in the winter.[51] Preliminary studies suggest that up to 25% of the population may suffer from SAD,[62] and that the prevalence in northern latitudes may be higher.[45] About 53% of SAD patients experience clinically significant relief of symptoms (often total remission) in response to morning bright-light treatments (usually of 1–3 hours' duration).[63] In order to be effective, phototherapy must be much brighter than ordinary indoor illumination (e.g., 2500 lux or more, as compared to 500 lux for a brightly lit office). It is also of interest to note that a significant number of patients suffering nonseasonal depressions respond favorably to bright light therapy.[50]

The high prevalence of SAD in extreme latitudes during the fall and winter and its response to light therapy suggest that SAD may be triggered by reduced light exposure. It is therefore interesting to speculate how shiftwork might affect people who are susceptible to SAD. At first, one might imagine that a person who works all night and sleeps during the day might be particularly "light deprived" compared to a dayworker. On the other hand, dayworkers employed indoors frequently are exposed to bright outdoor illumination at only two times each day—while traveling to work and while traveling home.[55] In winter, when the sun rises late and sets early, dayworkers may therefore experience no outdoor light at all. Nightshift workers, on the other hand, may be more likely to be out and about during the day, because this is free time for them, day sleep is often difficult, and some types of business can be conducted only during the day. Thus, night and rotating shiftworkers, if they go out in the daylight, may actually be at an advantage over dayworkers when it comes to avoiding SAD.

On the other hand, it has been proposed that SAD might be induced by mistimed light exposure rather than by insufficient light exposure. Some SAD patients derive therapeutic benefit only from bright light exposure in the morning, others respond only to evening light, and some respond to both.[63] Circadian studies suggest that light exposure in the middle of the day may have relatively little biological effect.[8] The timing of outdoor light exposure may therefore be critical in the induction or avoidance of depression. However, "the timing of light exposure" refers not simply to clock time but to the individual's internal circadian time. Thus, the effects of a shift schedule on SAD (or nonseasonal depression) may depend on a complex interplay between individual predispositions, initial circadian phase, lighting conditions on the job, and the timing of daylight exposures during nonwork hours.

The possible association between shiftwork and premenstrual depression also deserves special mention here. In a study of 1,199 female nurses, Tasto et al.[59]



found that "rotating shift nurses suffered more tension, nervousness, weakne and sickness at menstruation than did all other shifts, as well as significan longer menstrual periods than all other shifts." Rotating nurses also made mo clinical visits for menstrual problems in this study. Thus, it is possible th shiftwork may disrupt not only circadian cycles but monthly cycles as well. Pa et al.[42] have recently demonstrated in a controlled trial that (nonshift-workin women who suffer from premenstrual depression experience significant relief symptoms in response to evening treatment with bright light during the late lut phase. This suggests that inadequate (or perhaps mistimed) bright light exposu could be a source of premenstrual symptoms among shiftworkers.

Thus we see that shiftwork holds the potential, at least theoretically, f either exacerbating or alleviating various types of depression. We know th many people quit nightwork because it makes them feel worse. Perhaps oth actually seek it because it makes them feel better. To date, the empirical eviden in this area is too sparse to identify reliable effects of shiftwork on depression.

## BRIGHT LIGHT TREATMENT, SHIFT WORK, AND PSYCHIATRIC DISTURBANCE

If disruption of circadian rhythms contributes to psychiatric problems, if people with certain psychiatric problems are especially adversely affected shiftwork because they have unstable circadian rhythms, then it would desirable to find a method of restoring circadian synchronization among tho on shift schedules. Properly timed exposure to bright light holds great promi as a means of achieving this.

It has long been known that light is a powerful circadian zeitgeber virtually all plant and animal species.[39,49] Early experiments suggested that lig was not a very effective zeitgeber in humans. However, Lewy et al.[34] demonstrat that the pineal hormone melatonin, considered a marker for circadian rhythm could be suppressed by light in humans if the light was of sufficient intensity. Th opened the way for a flood of studies showing that very bright light is indeed powerful zeitgeber for humans and that it has effects qualitatively similar to tho already well recognized in other species.[8,11,75]

One way in which the effects of light on circadian rhythms can be describ is by the phase-response curve. This is a graph showing the direction a magnitude of the phase shift in a particular rhythm that occurs in response bright light pulses occurring at various times of the day and night. Although th phase-response curve to bright light in humans has yet to be filled out in deta preliminary results indicate that bright light pulses administered early in t morning cause phase advances in various rhythms, while pulses administered la in the night cause phase delays.[8,10,11,75] Repeated bright light exposures appropriate times can cause dramatic phase shifts in circadian rhythms, resy chronizing people to new 24-hour schedules in a matter of days.[8]

Thus, the potential relevance of bright light treatment to the wide variety shiftwork problems discussed in this volume is clear. Used correctly, bright lig (and judicious avoidance of mistimed bright light) could theoretically help peop rapidly adapt to shift schedules, overcoming problems with sleep, performanc psychological well-being, and perhaps medical well-being. We will focus here the implications of bright light for alleviating psychiatric problems in shiftwor

As discussed above, neurotic people seem to have the hardest time adjusti to shiftwork; they also seem to have circadian rhythms that are easily dissociat

from one another. There is good reason to believe that bright light treatment could strengthen the synchronization of these people to their shift schedules. Perhaps this would alleviate the subjective distress their schedules cause and thereby decrease the likelihood that they will leave their jobs.

We have mentioned that both seasonal and nonseasonal depressions respond favorably to bright light treatment. Perhaps the shiftworker suffering from these disorders could kill two birds with one stone by using the same light treatment as therapy for depression and as a tool for achieving adaptation to the shift schedule. A caveat is in order here. We must emphasize that the role, if any, of circadian phase maladjustment in depression is not clear. It is therefore possible that light treatments timed to optimize shift scheduling might not have the desired antidepressant effects. Furthermore, if circadian phase problems do cause depression, it is conceivable that the same light-induced phase shift that helps a worker adopt a new schedule might somehow worsen depression. Moreover, in susceptible people, bright light can evidently trigger mania.[31] Many more laboratory, clinical, and field studies will be necessary to determine the effects of various lighting schedules on shift adaptation and depression.

Eastman[12,13] used bright light treatment to help subjects adapt to simulated shiftwork in their home environment. She developed a special schedule in which the subjects tried to live 26-hour days to help them rotate between shifts. The schedule was based on the fact that in the absence of outside time cues, people tend to free-run with circadian rhythms longer than 24 hours. She used timed bright light exposures late in the subject's "night," plus avoidance of bright light early in the "day," in an effort to help them phase-delay their circadian rhythms in keeping with the new schedule. Bright light appeared to help three of the first four subjects' core temperature rhythms entrain to the new schedule; however, similar trials on an additional eight subjects produced only partial phase shifts of the temperature rhythm to the new schedule. It is possible that competing 24-hour zeitgebers interfered with the 26-hour schedule. Perhaps more important is the fact that, based on recent quantitative analyses of human circadian responses to bright light exposure,[8] the timing of Eastman's light treatments (two hours before bedtime) and their magnitude (2000 lux) may have been insufficient to produce the intended phase shifts. Brighter light treatments later at night might have produced more dramatic results. Despite the fact that subjects in this study experienced large changes in the phase angle between their circadian temperature rhythm and their sleep/wake rhythm, no significant impairments of mood (as measured by the POMS) were reported.

Eastman's work demonstrates that although light may have promise for shiftworkers, the optimal patterns of administration cannot readily be predicted. Extensive empirical trials are needed *for each pattern of shiftwork* to test phototherapy designs. Because millions of workers are impaired by work shifts yearly, a major program of experimental research is appropriate.

Another strategy for use of light would be to attempt nonspecific increases in illumination of nocturnal workplaces, especially in the areas where workers take meals and breaks. Such increases in illumination seem likely to accelerate circadian phase adjustments.

A final strategy would be to empirically examine what patterns of timing and intensity of spontaneous, uncontrolled illumination among actual shiftworkers minimize symptoms. A recently developed methodology of continuous illumination monitoring[50] would make it possible to record large numbers of shiftworkers



to find which light exposure patterns are associated with minimal symptoms f various shiftwork schedules.

## SUMMARY

There is little rigorous evidence that shiftwork produces specific psychiatr disturbances. Substantial evidence suggests that shiftworkers are prone increased drug and alcohol consumption, but the frequency with which this lea to actual drug abuse disorders has never been adequately defined. A preponde ance of studies suggests that symptoms of a "neurotic" character are overrepre ented among nightshift workers. The nature of these symptoms needs to b clarified with modern psychiatric nomenclature. It seems likely, based on certa experimental work, that nightshift work may at times exacerbate mood disorder leading to an impression of "neurotic" disturbance. At the same time, son conditions of shiftwork might actually palliate mood disorders. Therefore, reexamination of these issues is needed with improved research designs and mo careful characterization of the nature of workers' complaints, their psychiatr histories (i.e., personal and family histories of mood disorders and oth psychopathology), and possible specific effects of particular shiftwork rotatio schedules. Use of bright light to alleviate mood disturbances associated wi shiftwork needs extensive empirical testing.

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