

Using Bright Light and Melatonin to Adjust to Night Work

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PROTOCOL NAME

Using bright light and melatonin to adjust to night work.

GROSS INDICATION

This protocol is indicated for people who want to work on a later schedule.

SPECIFIC INDICATION

This use of bright light and melatonin is specifically indicated for people who are working at least 2 consecutive weeks of night shifts, and particularly for workers engaged in high-risk work, such as nuclear power plant operators and health care workers.

CONTRAINDICATIONS

As the circadian system is slow to shift, phase shifting the circadian clock is not useful for people working for less than 2 consecutive weeks of night shifts, such as part of a rapidly rotating work shift schedule.

Bright light should probably not be used in:

- people with existing eye disease;
- people using photosensitizing medications.

Bright light can induce:

- migraines (in about a third of migraine sufferers);
- mania (rare).

Melatonin should probably not be used in:

- people who are driving or operating heavy machinery (unless they have previously tested their response to melatonin and are taking <0.5 mg of melatonin);
- pregnant or nursing women (melatonin will transfer to the fetus/infant);
- women seeking to become pregnant;
- children (unless they suffer from a neurodevelopmental condition associated with extremely poor sleep);
- asthmatics and patients with gastrointestinal disease (melatonin may be inflammatory);
- patients using other medications (unless supervised by a physician).

RATIONALE FOR INTERVENTION

The circadian systems of night workers do not usually adjust to working at night and sleeping during the day. Instead, the circadian clock continues to promote sleep at night and wakefulness during the day. Thus, night shift work is associated with poor performance and excessive sleepiness during the night shift and poor daytime sleep at home. While hypnotics may pharmacologically induce daytime sleep, and stimulants (caffeine, modafinil) may reduce excessive sleepiness during the night shift, studies show that circadian-induced sleepiness during night shifts remains high [1–3]. Furthermore, the health effects of the long-term use of these medications are unknown. Shift workers also have an increased risk for accidents, and for reproductive, cardiovascular, and gastrointestinal disorders and cancer [4–6]. Many of these negative results are likely due in part to the chronic circadian misalignment that is characteristic of night work [7].

This chronic circadian misalignment is largely due to inappropriate light exposure that keeps the circadian clock on a daytime schedule. Appropriately timed exposure to bright light at night, and avoidance of morning bright light, can facilitate a phase delay of the circadian clock such that the circadian system promotes wakefulness at night and sleep during the day.

STEP BY STEP DESCRIPTION OF PROCEDURES

The following steps are to reshape the pattern of light exposure to facilitate the circadian clock phase delaying, or shifting later, to adjust to night work and daytime sleep. Many of these steps are illustrated in Figure 17.1. Daytime sleep also needs to be protected.

1. Avoid morning light by wearing dark sunglasses that are approved for driving on the way home after the night shift [8].
2. Go to bed early after the night shift [8].

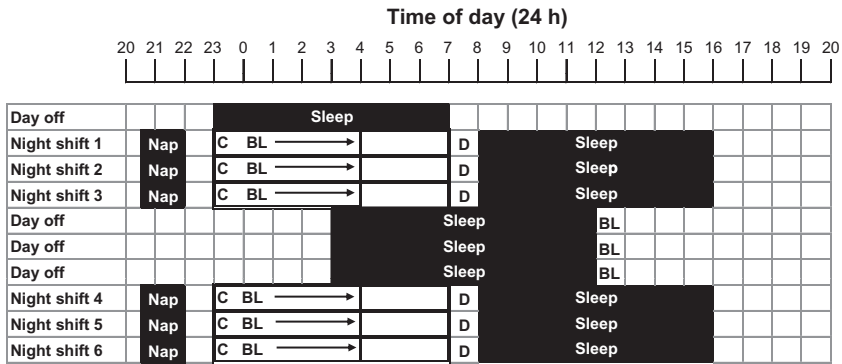


FIGURE 17.1 A sample plan for a night worker who wants to sleep right after the night shift. This worker begins the night shifts unadjusted. A nap is taken before the night shifts to reduce sleep pressure, and some caffeine (C) can be taken in the first 2 hours of the night shift to improve alertness but not disrupt later daytime sleep. Bright light (BL) is used intermittently from the start of the night shift to 4 am. Bright light during the commute home is avoided with the use of dark sunglasses (D), and sleep occurs soon after the night shift in a dark bedroom. Sleep on subsequent days off remains late to stay adjusted to the night shift. Bright light after noon on days off can help the worker from sleeping too late if he or she does not want to regularly wake later than noon.

- Maintain a light-tight bedroom. An inexpensive option is to tape black plastic over bedroom windows [8].
- Reduce exposure to potential noise disturbances by turning off telephones, using a white-noise generator, and installing rugs over hardwood floors (if family members are home during the day).
- If permissible, use a portable bright light box *at work until 4 am* [9]. The light box can be set up at your work station. You do not need to stare into the light box. Intermittent light exposure is still effective, so you do not have to sit in front of the light box the entire time [10,11]. Note the bright light will also keep you more alert [12].
- Try to sleep on a late schedule on days off (e.g., 3 am to ~noon), as this will make for an easier transition back to night shifts [9].
- If you have shifted too late and struggle to wake in the afternoons on your days off, half an hour of early afternoon bright light after 12 noon (from a light box or by going outside) will help shift you a little earlier [9].
- If permissible, try napping in the few hours before or in the first half of a night shift to reduce sleep pressure [13,14]. This is especially useful before the first night shift. Give yourself some time to get over any grogginess (sleep inertia) upon waking.
- To further improve alertness during the night shift, consider taking 200–450 mg of caffeine in the first 2 hours of the shift to improve alertness, but not disturb later daytime sleep [15].

POSSIBLE MODIFICATIONS/VARIANTS

As older people are more sensitive to circadian misalignment [16], they are likely to suffer even more from excessive sleepiness during the night shift and poor sleep during the day.

Morning types typically have more difficulty in adjusting to night shifts. Morning types have earlier circadian rhythms, and thus need to phase delay or shift their clocks more than evening types who are already on a later schedule [17]. A simulated night-shift study has shown that morning types are sleepier during night shifts [18].

Commercially available light boxes vary in their size, portability, and wavelength. Generally, larger light boxes, which cover more of the visual field, are less aversive, but smaller light boxes are more portable. Current research suggests bright blue-light boxes are no more effective than bright white-light boxes [19,20].

A potential criticism of the use of bright light to phase delay the circadian clock to adjust to night work and daytime sleep is that the time point of greatest sleepiness (normally around 4–6 am) may be shifted later to occur during the commute home [21]. This sleepiness may be further exacerbated by the use of dark sunglasses during the commute home. However, a study in real night workers suggest this occurs only temporarily as the time point of greatest sleepiness shifts later to occur after the commute home and well within the daytime sleep episode [11]. Thus, a few days of temporary sleepiness during the commute home (when driving is ill advised) needs to be balanced against permanent excessive sleepiness (and increased injuries and health risks associated with chronic circadian misalignment) if the circadian system is not shifted to facilitate good daytime sleep. Clearly, more research on morning driving performance in real night workers who are trying to shift later is required.

An alternative approach to adjust to night shifts is to phase advance or shift the circadian clock earlier to facilitate good sleep just prior to the night shift [22,23]. Sleeping just before going to work mimics what day workers typically do. In this case, morning bright light will facilitate a phase advance so there is no need for sunglasses during the commute home. A light box could be used *after 4 am* until the end of the shift. A high dose of melatonin (such as 3 mg) before going to sleep in the afternoon can help phase advance or shift the clock earlier [22,24], thereby facilitating the earlier onset of sleep. However, it is important to note that the feasibility and effectiveness of this alternative approach remains to be tested in real night workers.

Sometimes workers choose not to adjust their circadian clocks to night work in order to remain on a typical day schedule on their days off and thus most easily interact with their families, etc. In this case, naps, stimulants and hypnotics may be the only option.

PROOF OF CONCEPT/SUPPORTING DATA/EVIDENCE BASE

A study of nurses on permanent nights illustrated that the circadian systems in the majority of the nurses (25/30) had not phase delayed to adjust to the night shift [25]. The five nurses that were adjusted were exposed to less bright light in the morning and afternoon because they had darker bedrooms and stayed in bed longer.

Studies in real night workers, all nurses, have demonstrated the beneficial effects of light-based interventions on daytime sleep. In one study, bright light during the night shift increased total day sleep time by an average of 33 minutes [10]. Total sleep time further increased by 67 minutes when the nurses also wore dark sunglasses during their commute home. Similar improvements in night-time alertness were also observed. In a second study, nine nurses in a control group were instructed to go to bed 2 hours after the night shift, and slept in dark bedrooms [11]. Five of the nine nurses remained unadjusted to the night shift, and the group reported sleeping an average of 6.6 hours per night, which is typical of permanent night workers [26]. Ten nurses in the treatment group *also* wore dark sunglasses during their commute home and received bright light during the night shift. In this case, all 10 nurses adjusted to the night shift, and they reported sleeping an average of 7.3 hours per day (an extra 45 minutes of sleep per night) [27]. Simulated night-shift studies suggest that, for many young people, phase delaying the clock by about 5 hours or more can improve night-time performance so that they are close to baseline daytime levels [28]. More research measuring objective performance of real night workers during light-based interventions is needed.

Studies of real night-shift workers show that naps can improve performance and reduce accidents during the night shift without reducing daytime sleep quality, and are particularly effective for the first night shift [13,14].

To date, there is no strong evidence to support taking melatonin before daytime sleep that occurs *after* a night shift. In a study of nurses on the night shift, 0.5 mg of melatonin taken before daytime sleep helped less than one-third of the nurses phase delay to the daytime sleep schedule [29]. In terms of the hypnotic effects of melatonin, some placebo controlled studies in real night workers using relatively high doses (5–6 mg) have reported significant increases in the self-reported duration of daytime sleep of 26–56 minutes [30,31], but others report no such effect of melatonin [32]. Thus, more research is required to determine if such high doses of melatonin can improve objective measures of daytime sleep in real night workers.

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RECOMMENDED READING

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