

## CLINICAL REVIEW

# Use of sleep hygiene in the treatment of insomnia

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### KEYWORDS

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**Summary** Sleep hygiene (SH) refers to a list of behaviors, environmental conditions, and other sleep-related factors that can be adjusted as a stand-alone treatment or component of multimodal treatment for patients with insomnia. This paper presents a review of SH, how this concept has been applied and often modified over the past 24 years, and how it relates to the modern sleep disorder nosology, particularly Inadequate Sleep Hygiene. Although a recognized and commonly utilized treatment option, there is no absolute consensus about which steps must be included to constitute SH treatment, and there is much overlap between SH and other cognitive-behavioral treatments for insomnia such as Stimulus Control Procedures and Sleep Restriction Therapy. The literature on the effects of manipulations of individual components of SH under experimental conditions (e.g. effects of presleep alcohol or caffeine intake) in normal sleepers show mixed results. Empirical data demonstrating the role of poor SH as a contributor to insomnia, or showing that good SH improves sleep in patients with insomnia, is not available. Instead of evaluating the impact of a comprehensive list of SH recommendations, a focus on guidelines for use of individual rules is needed. © 2003 Elsevier Science Ltd. All rights reserved.

## INTRODUCTION

Sleep hygiene (SH) recommendations are almost uniformly included as part of cognitive-behavioral treatment programs for insomnia [1, 2]. "Sleep hygiene" refers to those behaviors that are believed to promote improved quantity and quality of sleep. This paper will review research that addresses the effect of manipulating sleep hygiene on the sleep of normal sleepers, as well as patients with insomnia.

## DEFINITIONS OF SLEEP HYGIENE

The term "sleep hygiene" was first used by Peter Hauri in the context of providing recommendations for patients to help them improve their insomnia [3]. The original list of SH instructions proposed by Hauri is presented in Table I. Some of these rules were derived from scientific studies regarding the effects of caffeine or alcohol on sleep, and others were the result of Dr Hauri's clinical observations of patients with poor sleep. These recommendations are generally aimed at having the individual avoid behavior that interferes with a normal sleep pattern, or to engage in behavior that promotes good sleep. Sleep hygiene recommendations have evolved with increased understanding of other behavioral factors that improve

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**Table 1 Original sleep hygiene rules\***

1. Sleep as much as needed to feel refreshed and healthy during the following day, but not more. Curtailing time in bed a bit seems to solidify sleep; excessively long times in bed seem related to fragmented and shallow sleep.
2. A regular arousal time in the morning seems to strengthen circadian cycling and to finally lead to regular times of sleep onset.
3. A steady daily amount of exercise probably deepens sleep over the long run, but occasional one-shot exercise does not directly influence sleep during the following night.
4. Occasional loud noises (e.g. aircraft flyovers) disturb sleep even in people who do not awaken because of the noises and cannot remember them in the morning. Sound attenuating the bedroom might be advisable for people who have to sleep close to excessive noise.
5. Although an excessively warm room disturbs sleep, there is no evidence that an excessively cold room solidifies sleep, as has been claimed.
6. Hunger may disturb sleep. A light bedtime snack (especially warm milk or similar drink) seems to help many individuals sleep.
7. An occasional sleeping pill may be of some benefit, but the chronic use of hypnotics is ineffective at most and detrimental in some insomniacs.
8. Caffeine in the evening disturbs sleep, even in persons who do not feel it does.
9. Alcohol helps tense people to fall asleep fast, but the ensuing sleep is then fragmented.
10. Rather than trying harder and harder to fall asleep during a poor night, switching on the light and doing something else may help the individual who feels angry, frustrated, or tense about being unable to sleep.

\* From Hauri (1977) [3].

**Table 2 Updated list of sleep hygiene recommendations**

1. Curtail time in bed.
2. Never try to sleep.
3. Eliminate the bedroom clock.
4. Exercise in the late afternoon or early evening.
5. Avoid coffee, alcohol, and nicotine.
6. Regularize the bedtime.
7. Eat a light bedtime snack.
8. Explore napping.
9. Monitor use of PRN hypnotics.

or worsen sleep. Hauri's list of SH rules is comprehensive, and includes a wide range of behavioral factors. An updated list of SH instructions by Hauri is listed in Table 2 [4]. This revised list is notable in that rules addressing cognitive features of insomnia were added. Therapeutic strategies for implementing Rule 2, "Never try to sleep", can be envisioned in different ways. One interpretation is not to have an insomniac go to bed until sleepy. However, once in bed, the individual is obviously "trying to sleep" and this can be counterproductive for an insomniac. Therefore, use of cognitive distraction techniques or guided imagery in bed might also be used to fulfill this rule. The recommendation to "Eliminate the clock" is aimed at reducing arousal during the night from unwanted cognitive activity.

There are countless other versions of SH rules that contain various additions to and deletions from the overall list. In some instances, sleep specialists have adopted more limited SH instructions that focus only on aspects of the sleep environment, effects of exercise, and use of caffeine, alcohol, and nicotine [5]. This version of SH is labeled a psycho-educational approach to the treatment of insomnia. The rationale for this definition is presumably that the more sophisticated cognitive-behavioral elements of SH are subsumed under other specific components of the treatment program, such as sleep restriction therapy and stimulus control therapy. Sleep restriction therapy (SRT) evolved from an attempt by Spielman, Saskin, and Glovinsky to systematically study the efficacy of sleep hygiene rules for the treatment of insomnia [6]. The first rule from Hauri's original list was to reduce time in bed in order to consolidate sleep (see Table 1). However, scientific assessment of this approach required a protocol to implement and measure the reduction in time in bed, leading to the treatment algorithm that defines SRT [6]. Although SRT evolved from a SH rule, current SH instructions often include only those elements that are unique and not part of these other treatment approaches. Arguably, this version of SH is less sophisticated, and a less robust treatment approach than the original rules as defined by Hauri. The SH rules as envisioned by Hauri clearly require complex cognitive and behavioral treatment for full implementation.

**Table 3** Definitions of sleep hygiene rules across studies

|   | Original SH rules: Table 1: Hauri (1977); [3] | Updated list: Table 2: Hauri (1992); [4] | ICSD Definition of inadequate sleep hygiene [8] | Schoicket, Bertelson, & Lacks (1988); [45] | Friedman <i>et al</i> (2000); [46] | Hauri (1993); [48] | Guilleminault <i>et al</i> (1995); [49] |
|---|---|--|---|--|------------------------------------|--------------------|---|
| 1. Decrease time in bed                   | X   | X  | X   |  |                                    | X                  |   |
| 2. Regular bedtime, arising time, or both | X   |  | X   |  |                                    |                    | X                                       |
| 3. Exercise                               | X   | X  | X   | X  | X                                  | X                  |   |
| 4. Eliminate noise from bedroom           | X   |  | X   | X  | X                                  |                    |   |
| 5. Regulate temperature of bedroom        | X   |  | X   |  | X                                  |                    |   |
| 6. Light snack at bedtime                 | X   | X  |   | X  | X                                  |                    |   |
| 7. Avoid use of sleeping pills            | X   | X  |   |  | X                                  |                    |   |
| 8. Avoid caffeine                         | X   | X  | X   | X  | X                                  | X                  | X                                       |
| 9. Avoid alcohol                          | X   | X  | X   | X  | X                                  |                    | X                                       |
| 10. Do not try to sleep                   | X   | X  |   |  |                                    |                    |   |
| 11. Eliminate bedroom clock               |   | X  |   |  |                                    | X                  |   |
| 12. Napping                               |   | X  | X   | X  |                                    |                    |   |
| 13. Relaxing activities before bed        |   |  | X   | X  |                                    |                    |   |
| 14. Limit liquids                         |   |  |   |  | X                                  |                    |   |
| 15. Hot baths                             |   |  |   |  | X                                  |                    |   |
| 16. Use the bedroom only for sleep        |   |  | X   |  | X                                  | X                  |   |
| 17. Leave bed if awake                    |   |  |   |  | X                                  |                    | X                                       |
| 18. Comfortable bed                       |   |  | X   | X  |                                    |                    |   |
| 19. Make worry list before bed            |   |  |   |  | X                                  | X                  |   |

An appreciation for the differences in the definition of SH is important when evaluating the scientific literature regarding its usefulness as a treatment for insomnia (see Table 3). Our review failed to find any two studies that used an identical set of SH instructions. The “core” SH instructions (i.e. those rules appearing in SH lists across studies) are those addressing caffeine, alcohol, and exercise. But the exact recommendations regarding these areas still differed. For example, some lists limit the total amount of caffeine intake, while others focus on the timing of caffeine intake.

Despite a lack of consensus on an exact definition of SH, sleep specialists commonly recommend SH as a treatment approach for patients with insomnia [7]. In the DSM-IV field trial, insomnia experts made treatment recommendations for patients presenting with insomnia. These specialists ranked SH as the most recommended treatment for patients diagnosed with psychophysiological insomnia and inadequate sleep hygiene. Additionally, SH was the second most commonly recommended treatment for patients with insomnia related to an anxiety disorder, and the third most recommended treatment for those patients diagnosed with obstructive sleep apnea syndrome, delayed sleep phase disorder, or insomnia related to a mood disorder [7]. Clearly, these specialists share the perception that SH recommendations are important in the treatment of any patients presenting with a complaint of insomnia.

## “INADEQUATE SLEEP HYGIENE” AS A DIAGNOSTIC CATEGORY

The International Classification of Sleep Disorders [8] published in 1991 introduced a diagnostic category called “Inadequate Sleep Hygiene”. This category

applies to those patients reporting insomnia or excessive sleepiness that is felt to result from their sleep habits (i.e. poor sleep hygiene). The behaviors that constitute inadequate sleep hygiene according to the ICSD are shown in Table 4. A patient must exhibit only one of these behaviors to qualify for this diagnosis. “Inadequate sleep hygiene” is one of several categories in the ICSD subsumed under the more general category of “primary insomnia” in the DSM-IV nosological system for sleep disorders [9]. However, a review of the literature published in 1991 concluded that there was not sufficient data to establish the validity of or reliability of “inadequate sleep hygiene” as a diagnostic category [10]. That study concluded that there was not sufficient evidence to conclude that inadequate sleep hygiene is a primary cause of insomnia, but may instead be a feature of other types of insomnia (e.g. psychophysiological insomnia).

Use of “Inadequate Sleep Hygiene” as a primary diagnosis was assigned to 6.2% of 216 patients presenting with a primary complaint of insomnia in the DSM-IV field trial [11]. However, this diagnosis was used very often as a secondary diagnosis since it was applied to 34.2% of all patients in the study. Therefore, the raters in that study often considered inadequate sleep hygiene as contributing to a patient’s insomnia, but were much less likely to view it as the primary cause of poor sleep.

## RESEARCH OF THE EFFECTS OF SLEEP HYGIENE RULES IN NORMAL SLEEPERS

Evidence regarding the importance of specific behaviors in contributing to disturbed sleep is found in

**Table 4 Inadequate sleep hygiene: ICSD definition**

1. Daytime napping at least two times each week.
2. Variable wake-up times or bedtime.
3. Frequent periods (two to three times per week) of extended amounts of time spent in bed.
4. Routine use of products containing alcohol, tobacco, or caffeine in the period preceding bedtime.
5. Scheduling exercise too close to bedtime.
6. Engaging in exciting or emotionally upsetting activities too close to bedtime.
7. Frequent use of the bed for non-sleep-related activities (e.g. television watching, reading, studying, snacking, etc.).
8. Sleeping on an uncomfortable bed (poor mattress, inadequate blankets, etc.).
9. Allowing the bedroom to be too bright, too stuffy, too cluttered, too hot, too cold, or in some way not conducive to sleep.
10. Performing activities demanding high levels of concentration shortly before bed.
11. Allowing mental activities, such as thinking, planning, reminiscing, etc. to occur in bed.

studies of normal sleepers. Representative studies are reviewed below.

### **Regular bedtime/waketime**

Recent research has documented that two principal determinants of sleep propensity and sleep consolidation are sleep homeostatic drive, which may be a broadly distributed system in the brain, and the endogenous circadian timekeeping system, thought to reside in the suprachiasmatic nucleus of the hypothalamus. Sleep homeostatic pressure builds in a roughly linear manner during normal (approximately 16 h) bouts of wakefulness, and declines precipitously during early sleep. Under entrained conditions, the circadian pacemaker maximally promotes wakefulness during the latter half of the waking day and maximally promotes sleep during the second half of the sleep episode. Thus, both processes combine to allow for a relatively constant level of alertness during the day and similarly stable sleep at night [12, 13].

Taken in the context of sleep hygiene, it has been shown that sleep episodes initiated in the few hours prior to normal bedtime have longer sleep latencies, due to the maximal wake promotion of the circadian system referred to as the “wake maintenance zone” [14]. The circadian system maximally promotes sleep in the proximity of habitual waketime, such that it may be considered a “circadian sleep maintenance zone”. Just as advanced sleep schedules show evidence of sleep onset problems, there is greater wakefulness intruding into the last third of sleep episodes that are initiated well after normal bedtime, when the sleep episode extends into the zone when the pacemaker switches over from the circadian sleep maintenance zone to the promotion of wakefulness.

In addition to alterations in sleep propensity and consolidation seen in isolated sleep episodes scheduled at earlier or later than habitually-timed, such altered schedules promote changes in circadian phase due to exposure to light. As demonstrated in numerous laboratory experiments (such as [15]), light exposure during the habitual night can either shift phase later (phase delay) or earlier (phase advance) relative to clock time. Thus, it can be concluded that in normal sleepers, adherence to regular bedtimes and waketimes promotes optimal sleep propensity and consolidation due to (1) sleeping in the phase range of circadian promotion of sleep, and, (2) proper, stable phase alignment of the circadian timekeeping system due to regularly timed exposure to environmental and indoor light.

### **Naps**

With the description of homeostatic and circadian modulation of sleep given above, the data on the effect of daytime napping on subsequent nocturnal sleep are not surprising. Daytime naps have been shown to decrease the depth of the subsequent major sleep episode and increase latency to sleep onset, likely due to lowered homeostatic sleep pressure leading up to nocturnal sleep onset [16]. This does not mean that napping is without potential positive applications. Naps have been shown to be beneficial in attenuating the decrements in mental performance associated with sleep loss associated with extended duty hours such as encountered in long haul airline pilots [17] or shift workers [18], who have difficulty obtaining sufficient daytime sleep. Thus, while naps are helpful in arenas where sleep cannot be obtained in sufficient quantity, naps are detrimental to subsequent nocturnal sleep under normal conditions.

### **Caffeine**

Caffeine is the most commonly-used substance to promote wakefulness and combat sleepiness [19]. Although capable of action in numerous ways, the wake-promoting effect of caffeine is thought to be due primarily through the blockade of adenosine receptors in the CNS. Adenosine has been proposed as an endogenous sleep promoting substance, and appears to follow the time course of the sleep homeostat [20]. Adenosine builds up during the course of prolonged wakefulness, and hence, caffeine acts to counter this process.

In contrast to the impression given by sleep hygiene recommendations, controlled acute administration of caffeine in normal subjects shows little effect on subsequent sleep. In a series of experiments, Landolt and colleagues [21, 22] administered 100 mg of caffeine at bedtime, and in a separate investigation, 200 mg of caffeine at waketime (100 mg is equivalent to approximately 1 cup of coffee or 2 cans of caffeinated soda). Polysomnographic analysis of subsequent nocturnal sleep showed remarkably little negative impact, with just noticeable increases in sleep latency and little effect on subsequent wake intrusion into sleep or sleep architecture. Caffeine did exert negative effects on the more subtle microstructure of sleep as indexed by EEG spectral analysis of slow wave activity, a putative marker of homeostatic sleep pressure.

## Alcohol

Alcohol has a well documented suppressant effect on subsequent nocturnal REM sleep. In addition, alcohol ingestion as far as 6 h prior to bedtime has been shown lead to significant fragmentation of subsequent sleep [23]. Daytime administration is known to decrease sleep latency on objective assessments such as the MSLT [24]. Thus, although these negative effects on sleep and daytime functioning are present, it is common for patients with insomnia to self-medicate with alcohol [25]. Surprisingly, under normal conditions, alcohol ingestion does not significantly shorten nighttime sleep latency of normal sleepers without sleep onset problems [26].

## Nicotine

While nicotinic cholinergic receptors are present in many brain regions, it remains unclear which are important for the effects of nicotine on sleep and daytime alertness, although it is clear that such effects are present. There is also little literature on the effects of nicotine on sleep in nonsmokers. In smokers, while early nicotine withdrawal has been associated with sleep fragmentation [27], one of the significant observed side effects of patch nicotine replacement is insomnia [28].

## Exercise

Many have thought that exercise may be a potential means of increasing the depth of sleep or hastening sleep onset. Data are decidedly mixed. There is little evidence that exercise completed early in the day has an effect on standard sleep parameters. Brief physical activity can significantly increase sleep latencies on the MSLT [29]. There is also evidence that exercise later in the day can increase the depth of sleep, as assessed by the percentage of slow wave sleep and total sleep time, but that exercise performed just prior to sleep onset may in fact delay sleep onset (reviewed in [30]). However, research has shown that it may not be exercise per se that influences depth of subsequent sleep, but rather heating of the body and/or brain [31].

## Body temperature and passive body heating

Given the findings of exercise on sleep detailed above, many studies have documented that increasing body

temperature prior to sleep through hot baths, so-called "passive body heating", can increase depth of subsequent sleep in both normal sleepers [32] and older insomniacs [33]. With regard to mechanism of body temperature changes and facilitation of sleep, there are data showing that increasing distal temperature relative to decreasing core body temperature is associated with faster sleep onset [34] and that a steeper downward slope of core body temperature is beneficial for sleep promotion [35]. These data are consistent with the earlier observation of a close link between the circadian rhythm of core body temperature and the self-selected bedtimes of subjects in time-isolation, free run studies [36].

## Alarm clock

Despite its inclusion in sleep hygiene instructions, the authors of this review were unable to find an objective study of the effect of having an alarm clock on nocturnal sleep. There are self-report data suggesting that individuals can act as their own alarm clocks, awakening at a predetermined time [37].

## TV

While it is also difficult to find experimental data on the effect of television watching on subsequent sleep, there are correlational data. In children, sleep problems were associated with the presence of a television in the bedroom and television watching prior to bedtime [38]. In settings such as the hospital ICU, televisions account for a significant percentage of peaks in noise intensity [39]. However, the opposite has been shown, with TV watching being associated with shorter mean sleep latencies on the MSLT [29].

## RATIONALE FOR USE OF SLEEP HYGIENE RECOMMENDATIONS IN THE TREATMENT OF INSOMNIA

Inclusion of sleep hygiene recommendations for patients with insomnia is based on the assumption that their poor sleep, at least in part, results from their violation of these rules. Most of the data relating specific sleep behaviors to quality or quantity of sleep has been conducted in normal sleepers, as reviewed above. There is not much data extending these findings to patients with insomnia. Patients with insomnia may

have specific mechanisms interfering with their sleep that are independent of SH, and would not necessarily be expected to show the same relation between SH behaviors and sleep quality. An analogy would be to study the effects of dietary habits in patients with gastro-esophageal reflux disease (GERD) compared to a control group of subjects who are asymptomatic. The control group might show little or no relation between eating spicy food and subsequent symptoms. Extrapolating these results to patients with GERD would obviously be inappropriate. The same risk applies to extrapolating studies of normal sleepers to patients with insomnia.

One approach to investigating this question is to compare normal sleepers and patients with insomnia with respect to the amount of poor SH they exhibit. The available data in this area are limited, and are conflicting.

Lacks and Rotert [40] found that patients with insomnia had equivalent knowledge of sleep hygiene rules as compared to normal sleepers, but were less likely to adhere to these rules. For example, although patients uniformly knew about the adverse effects of caffeine on sleep, they were still more likely than normal sleepers to consume caffeinated beverages in the evening.

A recent study by Harvey [41] compared 30 patients with insomnia to normal controls and found no differences in sleep hygiene practices between these groups. One exception was that the insomniac group had a lower sleep efficiency than the normal group, meaning that they spent more time in bed awake. This finding is hard to interpret since a lower sleep efficiency, besides suggesting a dimension of poor sleep hygiene, is part of the definition of insomnia. Patients with sleep efficiencies equivalent to those found in the normal controls would be unlikely to be categorized as insomniacs.

Although these studies suggest comparable levels of knowledge and practice of SH behaviors between normal sleepers and insomniacs, it could be argued that insomniacs should have more extensive knowledge and practice of SH. Given the model that certain individuals are predisposed to insomnia [42], they would be required to be more protective of their sleep than normal sleepers because of the greater consequences when SH rules are ignored. Violations of SH rules would presumably be more salient to this population. This is similar to the example of the GERD patient who must be more vigilant regarding the type and timing of food eaten than normal individuals.

## RESEARCH OF THE EFFECTS OF SLEEP HYGIENE RULES IN INSOMNIACS

It needs to be empirically determined if the relation between SH behaviors and sleep can be extrapolated from normal sleepers to all or certain groups of patients with insomnia. Additionally, besides group differences between insomniacs and normal sleepers, there may be significant individual differences among insomniacs regarding their sensitivity to violations of certain SH behaviors. That is, some individuals with insomnia may be especially sensitive to the sleep-disrupting effects of caffeine, while others are bothered little by caffeine. Therefore, studies of group differences might fail to show an overall effect with discontinuation of caffeine even though certain subjects experienced profound improvement.

Few studies have specifically set out to assess the efficacy of sleep hygiene recommendations as a “stand alone” treatment approach for the treatment of insomnia. Curiously, in some cases, investigators have elected to use a “sleep hygiene alone” treatment condition as a control condition to compare with those treatments they believe to be robust. In fact, a Practice Parameter paper from the Standards of Practice Committee of the American Academy of Sleep Medicine concluded that there is “insufficient evidence” to recommend sleep hygiene as a single therapy, and further, that there is not enough data to evaluate if sleep hygiene is effective in combination with other treatments [43]. In an accompanying review, it is concluded that poor sleep hygiene is unlikely to be a primary cause of insomnia, but may contribute to insomnia from another cause, and therefore “sleep hygiene education” is a necessary, but not a sufficient treatment approach [44].

An additional concern when considering this research is that SH is often used as an “active placebo” in these studies. Therefore, the investigators/therapists may not have presented SH treatment with the same enthusiasm or sophistication given to the active treatments. If the subjects saw the SH treatment as less credible this would be expected to decrease its effectiveness.

One study compared sleep hygiene, meditation, and stimulus control therapy using self-report measures of sleep [45]. In this study, sleep hygiene instructions consisted of: (1) no alcohol within four hours of bedtime, (2) no caffeine after 4 p.m., (3) no vigorous exercise within 2 h of bedtime, (4) no napping during

the day, (5) engaging in nonspecific relaxing activities before bedtime, (6) not going to bed hungry or thirsty, and (7) sleeping in a comfortable environment including regulation of noise, temperature, and mattress quality. All treatment approaches were found to produce statistically significant reductions in WASO, and the groups were not different from each other on this variable. In the SH group, WASO decreased from 81 min to 50 min at follow-up (6 weeks after the end of treatment). However, those patients in the sleep hygiene treatment group were less “satisfied” with treatment and were still more likely to complain of poor sleep compared to subjects in the other treatment groups. This study did not include either a placebo control condition, or objective measurement of sleep parameters, and therefore it is not possible to determine the extent to which demand characteristics may have influenced the results.

Friedman *et al.* [46] compared three treatment approaches, sleep restriction therapy, SRT with sleep hygiene, and sleep hygiene alone, in the treatment of older adults with insomnia. Sleep hygiene was an active control condition used to compare the benefit of adding SRT in the treatment of insomnia in older adults. In this study, the sleep hygiene instructions were: (1) follow regular schedules for eating and other daily activities, including exercise, (2) limit use of caffeinated beverages to two cups prior to lunch, (3) limit alcohol intake to one drink with dinner, (4) limit the intake of liquids to one glass within three hours of dinner, (5) use of hypnotic medication is forbidden, (6) take a warm to hot bath 2 h before bedtime, (7) have a light snack at bedtime, (8) write down a list of problems to be solved and tasks to be performed the next day, (9) develop and follow a regular bedtime routine, (10) use the bedroom only for sleep, (11) keep the bedroom at a moderate temperature, (12) eliminate noise from the bedroom, and (13) if awake after 15 min, leave the bedroom until feeling sleepy. This set of SH instructions varies from others in that it includes elements of two treatment approaches usually seen as independent of SH: stimulus control therapy and passive body heating. Actigraphy was used as an objective measure of sleep. Sleep parameters did not change significantly for the SH group as measured by actigraphy. Sleep efficiency increased from a baseline of 84.3–88.7% at follow-up (3 months after treatment). None of the three treatments in this study differed significantly from the other.

A study of several behavioral treatments in older adults included sleep hygiene alone as one of the treatment conditions [47]. This study had a measurement

control group that received no active treatment. Sleep log data was used, and polysomnography was available for about half of the subjects. Sleep hygiene education was also provided to the subjects in the other active treatment conditions (stimulus control and progressive muscle relaxation). No active treatment group showed improved sleep compared to the control group using ANOVA or ANCOVA (using baseline values as the covariate in an analysis of post-treatment and follow-up values). This was true for sleep log data as well as polysomnographic data.

Hauri [48] describes the effectiveness of customized sleep hygiene suggestions given to patients during a single 90 min interview with a sleep specialist. The most common suggestions concerned watching TV or reading in bed, increasing evening exercise, lifestyle changes during the day, or reducing time in bed. Telephone follow-up evaluations conducted at one, three, and six months after treatment found that the majority of the patients implemented the recommended changes, and a majority of those patients reported improved sleep as a result. A limitation of this study is that some patients were given non-sleep hygiene treatment suggestions that included relaxation training, medication changes, or psychotherapy. Hauri makes the argument that use of customized SH suggestions is preferable to giving patients the entire list of SH rules. Patients given the entire list are likely to invest time in making some changes that help them little or not at all, and therefore spend less time focusing on those behaviors of greatest significance to their own problem sleeping.

A final study compared SH alone, SH with exercise, and SH with morning bright light treatment [49]. Sleep hygiene in this study was defined as keeping a regular sleep-wake schedule, leaving the bedroom when unable to sleep and returning to bed when drowsy (stimulus control therapy), a regular meal schedule with dinner at least 3 h prior to bedtime, no alcohol after 4 p.m., and caffeine only at breakfast. Sleep logs and actigraphy were used to measure treatment outcome. Only the SH with bright light condition showed statistically significant improvement in total sleep time and sleep onset latency at post-treatment. The SH alone group was unchanged according to both self-report data and actigraphy. A key problem with these data in regard to evaluating the efficacy of SH treatment is that stimulus control therapy is included for all subjects. So, despite the use of the label “Sleep Hygiene Alone” as a description for one of the treatment conditions, this treatment is confounded with stimulus control therapy.



## CONCLUSIONS

Data from normal sleepers clearly demonstrate that sleep quality and quantity are adversely affected when certain sleep behaviors are followed. These data support the assumption that poor sleep hygiene can cause worsened sleep. The magnitude of the disruption of sleep varies considerably among the behaviors studied. For example, the effect of caffeine is small compared to the effect of sleeping during the wrong circadian phase. Some patients with insomnia report clinical improvement once they adhere to sleep hygiene rules, but the empirical evidence for the success of SH as a stand-alone treatment approach is very limited. One limitation to this research is that the term “sleep hygiene” is used by different investigators to describe diverse sets of rules, rather than a uniform treatment approach as use of a common term would imply.

The wide popularity of SH recommendations by sleep specialists appears to be out of proportion to the available data demonstrating the efficacy of this approach. Robust effects in improving the sleep of patients with insomnia using SH would not necessarily be expected if their insomnia were due to certain common causes of insomnia, such as a primary psychiatric or medical disorder. The view that poor sleep hygiene may contribute to insomnia, but not cause it, is supported by the finding that sleep specialists rarely used “inadequate sleep hygiene” as a primary diagnosis, but commonly used as a secondary diagnosis. One way to view the role of poor sleep hygiene in producing insomnia is to describe it in the context of Spielman’s theoretical model of chronic insomnia [42]. This model views contributing factors according to whether they are predisposing, precipitating, or perpetuating factors. Insomnia results when an individual with a predisposition to poor sleep encounters a precipitating event. Poor sleep hygiene is best viewed as a perpetuating factor in that many of these behaviors occur in response to difficulty sleeping. Increasing time in bed, eating during the night, or self-medicating with alcohol are examples of “inadequate sleep hygiene” that patients with insomnia may engage in once they are awake at night.

Basic research is needed to evaluate the importance of individual sleep hygiene rules in contributing to sleep disturbance in insomniac patients, similar to what has been done in normal sleepers. Additionally, research aimed at evaluating the incremental benefit of adding SH to either cognitive-behavioral treatment

programs, or to pharmacological treatment programs, would be useful in improving the understanding of the role of poor sleep hygiene in contributing to insomnia.

### Practice Points

Sleep hygiene rules:

1. Address key behaviors under the control of the individual that when modified, can help ameliorate the complaint of insomnia.
2. May vary from publication to publication, but most versions contain the core factors of bedtime/waketime, alcohol and drugs (caffeine, nicotine), sleeping environment (temperature, comfortable bed, noise), and exercise.
3. May bring on an episode of insomnia or may develop subsequent to the onset of an episode and perpetuate the episode.

### Research Agenda

Subsequent sleep hygiene research should:

1. Identify the relative contribution of individual behaviors (e.g. caffeine) in the maintenance of insomnia in individual cases who violate a specific SH rule.
2. Evaluate the underlying mechanisms whereby sleep hygiene factors influence sleep.
3. Find predictor variables that indicate when sleep hygiene rules may be an effective treatment or treatment component for a given patient with insomnia.

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