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Mini Review

Does Pre-Sleep Lighting Facilitate Sleep?

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Abstract

The following commentary paper discusses lighting and sleep quality. The young adult population is one of the most sleep deprived populations. There are a limited number of studies examining the effects of lighting and sleep quality in the young adult population. The biomedical science of technical elements of luminescence lighting levels has been extensively studied. The correspondence of lighting to other environmental factors such as noise has been investigated and has been identified. Pilot data of the type of lighting at pre-sleep is presented to provide context to the partial review of biomedical studies of lighting and sleep.

Does Pre-Sleep Lighting Facilitate Sleep?

Sleep is determined from two factors, the homeostasis of sleep need and sleep and the timing of sleep in the twenty-four-hour day [1,2]. Young adult sleep is one of the more sleep deprived populations largely due to the vulnerability of sleep schedules as they are subjugated from social, academic and work schedules leaving sleep, for the young adult population as a last priority [2,3]. Biomedical investigations of sleep have sought to determine effective ways to diagnose sleep disturbances, enhance treatments of sleep disturbances and to identify the biological infrastructure initiating sleep disturbances [3-5]. These influential studies are instrumental to bridge the gap between biomedical science and clinical medicine (i.e., the diagnosis and treatment of sleep disturbances). It is possible that the biotechnology of lighting, with additional empirical findings, may contribute to the identification of lighting trigger factors related to poor sleep quality, thus paving the way for the design of lighting treatments for poor sleep. Table 1 illustrates the basic description of sleep [6-8].

Biomedical research in the area of lighting has identified the role of natural light as well as artificial lighting that impacts health, including sleep [9]. Further, the vulnerability of lighting differences for some may be a sufficient factor to precipitating poor sleep [10-13]. The point has been made that the use of artificial lighting has been detrimental to circadian rhythm settings important to sleep. However, more recent work points out the absence of natural light exposures rather than overuse of artificial light as influential to poor sleep quality [11].

Domestic and community light at night has detrimental effects on sleep timing. The projections estimate radiance and extent of environmental light will grow 2% annually from current numbers (i.e., based on satellite studies). Reports of children and teens being susceptible to evening light exposure hours preceding scheduled bedtime [9]. The experience of lighting can potentially be balanced with respect to both the visual and tailored light systems. However, a conscious approach is essential as typical lighting exposure for young adults is 40% LEDs, approximate 30% fluorescent lighting and a varied and small natural light exposure in young adults [8,14]. Academic and industry studies have quantified the beneficial role of daylight exposure on worker productivity and school performance [15,1,16]. Other environmental stressors contribute to disturbed sleep patterns with noise as the predominant influence on sleep quality [1,9]. A meta-analysis identified examining light, sound and combined effect as substantial [9]. Ocular light exposure imported influences on human health with modulations in circadian rhythms, sleep, and decrements in neuroendocrine and cognitive functions [5,8,15,17]. Thus, adjusting lighting to promote physical and mental health and performance would be beneficial to the young adults sleeper. Testing of specific luminance's in the evening has yielded some possible advantage to low level light-pink or red hues (i.e., less than 20 lux) [5,10,16] Also the undesirable effects of extending LED/bright evening light such as in night classes, evening academic work can be mitigated by bright light exposure earlier in the day [17]. The results of lighting settings have been benefits to alertness, performance and sleep, the application of light therapy for clinical conditions such as SAD and circadian rhythm sleep disorders to improve circadian regulation and alertness in night and shift workers [1]. These findings support the consideration of lighting treatments.

Table 2 lists data from an exploratory study of lighting and sleep quality in young adults for one week. Participants logged their sleep and were requested to use a smartbulb with a setting of lighting that they preferred fifteen minutes prior to their typical bedtime. The participants strongly favored the use of the smartbulb lighting at pre-sleep. The weekly average of sleep efficiencies ranged from 77 to 93 percent. Half of the students selected blue or purple (less than 30 lux) light and the other half of participants selected a red light (approximately 11 to 18 lux). All the participants were fulltime students living in residence halls. On average, the participants were exposed to artificial lighting in classrooms, library, laboratories, music practice rooms and gymnasium at 500lux or more for five to eight hours. Further, many used the overhead light in the residence hall room in the evening which ranged at 450 to 550 lux depending on whether additional desk lamp/lamps were used in the room. The smartbulb fifteen-minute time at presleep was to be completed with the smartbulb luminescence only. For all participants, the use of the smartbulb was rated as relaxing. However, the study was exploratory and lacked a counter treatment to rule out reactivity to the design procedure, a comparison group and larger, representative sampling which are essential to confidence in the consideration of findings. However, the receptivity and favor or the use of a smartbulb, the ease in use of the lighting modification with a smartbulb and lighting assignment illustrated in this exploratory study suggest that some of the biomedical science of lighting influences on sleep could be translated to positive effects of improving health/sleep health [2,8].

Table 1: Sleep Architecture.

nREM	1 Low voltage, mixed frequency brain waves	Transition from wake
	2 Low voltage/frequency with spindles, reduced Muscle tension	consolidation
	¾ Increased high voltage SWS activity, Some body movements	Transition stage 3 to 4,
REM	Low voltage, mixed frequency brain activity, regulation,	Dreaming, mood
	Muscle atonia, Irregular heart rate and Breathing	memory consolidation
Optimal sleep: 5%nREM1, 55%nREM2,22%nREM3-4, 18%REM		

Table 2: Participant selection of smart bulb color for pre-sleep fifteen-minute exposure.

Participant	Age	Gender	Color*	Sleep Efficiency**
1	19	F	Purple	83
2	19	F	Blue	77
3	22	F	Blue	78
4	20	M	Red	92
5	20	M	Red	87
6	19	M	Red	83

Note*: Patients selected their preferred color on the smart bulb and then use them for all seven nights of the study for fifteen minutes at pre-sleep onset. **=Patients' sleep log records computed the average sleep efficiency for the week of recording where sleep efficiency is equal to total sleep in minutes divided by total sleep time in minutes times one hundred; optimal sleep efficiency is 85%.

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Conflict of Interest

None.

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