Daylight Exposure in Relation to Sleep, Wakefulness and Health

Arne Lowden, Göran Kecklund, Torbjörn Åkerstedt, Linda Magnusson Hansson, Hugo Westerlund.
Stress Research Institute, Stockholm University

Abstract

Daylight exposure might be essential for regulation of circadian rhythms, mood and sleep. To further test this, the Swedish Longitudinal Occupational Survey of Health (SLOSH) of 2012 was analysed. The database included workers studied at year 2012 (N=7324) and 2014 (N=15359).
On workdays daylight outdoor exposure was ≤1 h in 55 % for in-door workers, exposure being longer in males and increasing by age. Exposures increased on free days (≤1 h =13%). At work, 86 % worked within 5 m from a window. Those having problems with lowered mood, fatigue and lack of energy in autumn/winter amounted to 50 % and 22 % reported marked/severe problems.
A multivariate analysis showed sleep problems were related ($p<0.001$) to lack of light exposure in connection to work (and leisure) and distance to window. The relationship was most pronounced for difficulties to initiate sleep, waking, repeated awakenings, not being restored, mental and physical exhaustion. Light exposure was associated with an earlier onset of sleep ($p<0.001$) as well as an earlier rise time ($p<0.001$). Self-rated health was lowest in the group with low daily exposures (<30 min).
In summary, data clearly indicates that lowered exposure to natural daylight among in-door workers negatively affects sleep, possible daytime functioning and health perception.

Introduction

The light/dark cycle has been demonstrated to be crucial for the in regulation of circadian adjustment and entrainment. This is for example shown for populations that lack the ability to sense light cues like in the blind (1) but also for experimental conditions such as in dim lighting (2). In modern 24/7 societies exposure to electric lighting and use of electronic equipment has changed light exposure patterns that also have implications on sleep/wake patterns and health.

Sleep

Sleep is often evaluated according to factors relating to timing, length and sleep quality. The factors are regulated through the basic conditions of time since last sleep occurred and time of day when sleep is initiated. Wakefulness builds up a sleep pressure (need of sleep) to secure the recuperation of brain and body. The timing of sleep will affect sleep length and content of various sleep stages affecting daytime performance, but also the immune system and long-term health. Environmental factors such as noise and room temperature have great importance but also the state of the organism regarding for example stress and health status. Sleep may be measured through questionnaires and in large sample studies obtaining normal sleep habits in connection to work and leisure as well as sleep complaints past 3 or 6 months. More detailed sleep/wake patterns is possible to obtain through objective measures including use of of motion loggers that may detect sleep patterns across several days. When subjects cannot use electricity for lighting (ie camping) and only depend on natural daylight for regulating the sleep they show an advance in sleep timing and circadian patterns as compared to when depending electric lighting (3). Interesting, data from the Amazonas studying workers in a 12:12 dark light cycle demonstrate that workers with electricity in their homes show a delayed sleep onset and reduced sleep duration in connection to work days when compared to workers without electricity (4). It also seems that a natural short natural light exposure is a predictor for insufficient sleep (5).

Seasonal patterns

In Scandinavia the length of the day periods varies greatly around the year, above the Arctic Circle the length ranges from 0-24 hours showing. The differences are rapid, for example, at spring time there is a 5 min daily increase of daylight. Seasonal variation is naturally depending on latitude and workers show significant differences in total natural exposure (5). However, subgroups such as shiftworkers and in-door workers do not necessarily show differences not even comparing Equatorial and Artic regions (5)

Health and natural daylight

Marqueze has in her nice overview of the literature (5) highlighted the works by Benedetti & Terman (6) and others that have pointed out that mood disorders seem to increases with distance from the Equator, and that it therefore would be related to latitude. However, some authors have not found significant impact on sleep complaints and depression (7). Reasons for these mixed results as indicated by Marqueze (5) may be that a depressive mood might be more reactive to the seasonal variation of light exposure than sleep and rest activity patterns (8). Another explanation is that the relationship between sleep and mood might be bi-directional, i.e. that changes in sleep during winter precede changes in mood. Mersch et al. (9) emphasized factors like climate, genetic vulnerability and social-cultural context may play a more important role than light on the prevalence of depression and seasonal affective disorder (SAD). However, there might also be an interaction between vulnerability and exposure, e.g. individuals who are more sensitive to variations in natural bright light might report more complaints of seasonal mood variations (10). Finally, it has recently been suggested that people living at extreme latitudes may more openly express a vulnerability to seasonal change, whereas such vulnerability is latent in tropical areas (11).

Methods

The study is based on the Swedish Longitudinal Occupational Survey of Health (SLOSH) study, a cohort study with multiple repeated measurements at year 2012 (N=7324) and 2014 (N=15359). Questions on estimated natural daylight exposure in connection to work days and days off were included, distance to window at work and health items. Sleep timing in connection to work and leisure was reported as well as sleep & mood complaints and background variables (age, gender and education) was collected. Regression analysis models and logistic regressions were performed in order to predict health outcomes from natural daylight exposure.

Results

On workdays the reported daylight outdoor exposure was ≤1 h in 50 % for in-door workers, exposure being longer in males and increasing by age. Exposures increased on free days (≤1 h =13%). At work, 86 % worked within 5 m from a window. Those having problems with lowered mood, fatigue and lack of energy in autumn/winter amounted to 50 %. Of these, 22 % reported marked/severe problems.
In the next step we excluded the subgroup reporting having problems all year around, independent of season (9 %). Two groups were compared, those having seasonal problems in winter and those not having problems. A logistic regression analysis controlling for age, gender and education revealed that daylight exposure on work days constitutes a protection factor and the likelihood of having problems were reduced by 16 %. Daylight exposure on free days gave a stronger protection effect (20 %). Also exercise proved to be protective (14 %).

A multivariate analysis (control: age, sex, education) only using in-door workers showed sleep problems were related ($p<0.001$) to lack of light exposure in connection to work (and leisure) and distance to window. The relationship was most pronounced for difficulties to initiate sleep, waking, repeated awakenings, not being restored, mental and physical exhaustion. Light exposure was associated with an earlier onset of sleep ($p<0.001$) as well as an earlier rise time ($p<0.001$). Self-rated health was lowest in the group with low daily exposures (<30 min).

Conclusion

Mood and sleep complaints during the winter season are very common among a majority of Swedish workers. This study shows that this partly is partly due to natural daylight exposure on work days and on free days. A lowered exposure among in-door workers is related to negative sleep outcomes and health perception.

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