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Sleep and fertility

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Abstract

It has been noted that the quality of sperm has deteriorated at the same time as sleep disturbances have increased in societies around the world. Sleep has a holistic impact on human health, including sexual and reproductive health. This article describes what sleep is, why it is so important to health, how it affects hormones and therefore fertility, and how, as a professional, one can advise youth and young adults to protect and improve their fertility by prioritizing sufficient and high-quality sleep. This information can be used in health guidance of youth and young adults, and training future health professionals in better preconception health awareness.

Key words: sleep, fertility, preconception health, hormones

Tiivistelmä

On huomattu, että siemennesteen laatu on heikentynyt samaan aikaan, kun unihäiriöt ovat lisääntyneet. Uni vaikuttaa kokonaisvaltaisesti ihmisen terveyteen, myös seksuaali- ja lisääntymisterveyteen. Tässä artikkelissa kuvataan mitä uni on, miksi se on terveydelle niin tärkeää, miten se vaikuttaa hormoneihin ja sitä kautta hedelmällisyyteen ja miten voit ammattilaisena neuvoa nuoria ja nuoria aikuisia suojelemaan ja parantamaan hedelmällisyyttään priorisoimalla riittävän pitkät ja laadukkaat yöunet. Saat tämän artikkelin avulla tietoa unen vaikutuksesta hedelmällisyyteen, voit hyödyntää tietoa ohjatessasi nuoria ja nuoria aikuisia hedelmällisyyden suojelemaan.

Introduction

Does quality and quantity both matter? Yes, it does, when it comes to sleeping. Calculating hours of sleep is important, but so is assessing the quality of sleep. In the pursuit of better sleep, it is most often started by counting the number of hours spent in bed. The amount of sleep is a good starting point, but in addition to that, the focus must also be on the restfulness and quality of sleep. It would be optimal to maximize both, the amount and quality of sleep, to promote health and fertility. (Walker 2017.) The recommended amount of sleep in adults is seven to nine hours every night. This does not mean time spent in bed. When sleeping, eyes are closed, the smart phone put away, and the TV is in a different room entirely. (Walker 2017.)

The quality of sleep means how well one sleeps. An adult's good quality sleep means falling asleep in less than 30 minutes, sleeping through the night, waking up once at the most, and then falling asleep again within 20 minutes. Poor sleep involves difficulty falling asleep, staying asleep, and restlessness when sleeping. The quality of sleep is more difficult to measure than the amount of sleep. (Walker 2017.)

To sum it up, both the amount and quality of sleep are relevant. Sleep loss and poor sleep quality both cause physical and mental exhaustion. Neither quantity or quality should be compromised, since both good quality and consistent sleep allows for an optimal amount of restoring sleep. (Walker 2017.)

The importance of sleep

A person sleeps about a third of his or her whole life. Sleeping is perceived as passive and somewhat useless, but in fact many bodily functions and the brain are very active. The brain works almost as efficiently as when the person is awake. (Cirelli et al. 2006.)

During the day, waste material accumulates in human organs, which must be removed. Waste material also accumulates in the brain because of metabolism, and that must also be removed. In other parts of the body, this waste management is carried out by a lymphatic system. The lymphatic system does not reach the brain; therefore, the brain must have its own purification system. (Hablitz et al. 2019.)

This system, glymphatic system, works mainly during sleep. The glymphatic system is a functional waste clearance system for the vertebrate central nervous system (CNS). While sleeping, cerebrospinal fluid flows through the brain tissue and flushes the waste out of the brain. Efficient brain waste management requires deep sleep. A short or decreased amount of deep sleep impairs the glymphatic system and can cause neurological diseases in the long run. (Hablitz et al. 2019.)

For a long time, it was thought that sleep is important primarily in restoring brain function. It is currently known that sleep has a strong impact not only on normal brain function, but also on metabolism, immunity, and cardiovascular function. In addition, sleep has a major effect on normal endocrine function. (Andersen & Tufik 2008.)

Regular circadian rhythm ensures hormonal balance

Sleep affects health and well-being in many ways. Sleep and circadian rhythm -dependent human biology is strongly linked to fertility biology, which explains why sleep is so essential for good fertility (Palnitkar et al. 2018).

Normal hormonal activity of women is based on cyclicity and a circadian rhythm. It can even be stated that women's sexual and reproductive health depends on a regular circadian rhythm down to a molecular level, each fertility-related activity benefits from

wakefulness, sleep, and their regular cycles. (Sen & Sellix 2016.) Men's endocrine function is also dependent on a regular circadian rhythm. Testosterone secretion follows the circadian rhythm and is highest during sleep (Rose et al. 1972). The prolactin hormone is also important for male fertility, the secretion of which also occurs during sleep (Spiegel et al. 1994). Studies have shown that men with sleep apnea have lower testosterone levels, even when overweight is excluded as underlying reason (Hammoud et al. 2011). In summary, there is some understanding of the links between male fertility and sleep disorders, but all sleep disorders and their specific effects are difficult to research. Many connections are indirect through hormonal balance and primary health. When poor sleep impairs health, it usually also impairs hormonal balance and therefore, sexual and reproductive health (Palnitkar et al. 2018).

As noted, normal testosterone levels require good and high-quality sleep. Low testosterone levels cause symptoms typical of menopause in men, or andropause, without it being connected with age. These symptoms include impaired sexual desire and erection, decreased intellectual performance, reduced muscle mass, reduced bone mineral density and increased visceral fat. Andropause also causes the testicle tissue to decrease. (Andersen & Tufik 2008.)

Sleep and fertility

The effect of sleep on fertility has only been researched more in recent years. It is still uncertain whether the effects are due to the amount of sleep or the quality of sleep. Kloss et al. (2015) presented a model in which the effect of sleep on fertility was approached by three different factors. In this model, stress, sleep regulation disorders and normal circadian rhythm disorders were thought to explain the effect of sleep on hormones and,

by extension, fertility. By repairing sleep, hormones function normally in balance, restoring the conditions for fertility.

Kloss et al. (2015) reported that sleep disorders are associated with infertility through at least three different mechanisms of action. The first is the activation of the hypothalamus-pituitary-adrenal gland (HPA) axis, which increases sleep disturbances, while also interfering with reproduction. Secondly, they explain that the changed sleep duration and ability to stay asleep can in themselves hinder conception, since the HPA axis is overly activated. Thirdly, disorders in the normal circadian rhythm in itself, can cause infertility.

In terms of protecting fertility, maintaining a normal and regular circadian rhythm supports the body to function as it should, in balance. As a consequence, the menstrual cycle is regular, ovulation occurs in its time, and the quality of the sperm remains good with the help of good testosterone levels.

Sleep disorders and fertility

Sleep disorders bring with them a wide range of health challenges. In a woman, sleep challenges can arise for a variety of reasons, but hormonal causes are related to menstrual cycles, pregnancy, or menopause. It seems that the quality of sperm has deteriorated around the world at the same time as sleep disorders have increased in our societies. It is suspected that behind sleep disorders and unexplained infertility there is sleep-time oxygen deprivation, oxidative stress, low-level inflammation, insulin resistance and elevated blood fat levels (Palnitkar et al. 2018). In women, for example, polycystic ovarian syndrome (PCOS), which causes infertility, is linked to sleep disorders (Fogel et al. 2001).

Shift work can cause menstrual and fertility disorders, increase the risk of miscarriage, and cause low birth weight in the infant

(Goldstein & Smith 2016; Sen & Sellix 2016). For shift workers, it takes longer to conceive (Zhu et al. 2003) and their ovarian reserve has decreased (Mínguez-Alarcón et al. 2017).

Sleep disorders have been studied to increase appetite and hunger. A sleep deprived person needs to eat more, and normal control can easier be lost. Too little sleep can increase insulin resistance and therefore, increase the risk for diabetes. Low levels of sleep also hinder normal metabolism, which can increase blood glucose levels. Focusing on adequate sleep length and quality effectively prevents the overweight and diabetes risk. (Goldstein & Smith 2016; Reutrakul & Van Cauter 2018.) Overweight and metabolism disorders are a significant risk to fertility. Sleep disorders may also cause biological changes in the same way as stress and may affect fertility (Goldstein & Smith 2016). Insomnia can greatly reduce the outcome of infertility treatments and, on the other hand, good sleep can be a good and cheap way to improve the chances of success in IVF-treatments (Goldstein & Smith 2016).

Promoting good sleep

Increasing the amount of sleep is easier than improving its quality. One can easily increase the sleep volume by going to bed earlier or waking up later. Extending sleep time by 30 minutes at each end can improve sleep quality and improve its' restorability. (Walker 2017.) In fact, time spent in bed is not always the same as the time spent sleeping. Sleep time can be reduced by electronic devices in the bedroom and poor sleep hygiene. Poor sleep hygiene is clearly accompanied by practices that harm sleep, e.g. drinking coffee, tea, cola, or energy drinks in the late afternoon or in the evening before going to bed. Consuming alcohol in the evening also affects the quality of sleep. Alcohol may feel relaxing at first, but it adversely affects the quality of sleep.

Physical activity in the evening can lead to restless sleep and extra awakenings at night. In smokers, nicotine acts as a stimulant in the evenings and again the lack of nicotine can cause waking up too early. (Walker 2017.)

Electronic devices (smart phones, TV's, tablets) glow artificial blue light. Blue light interferes with the secretion of the sleeping hormone, melatonin. It confuses the body's internal clock, which notifies when it's time to sleep and wake up. The longer one spends in shining blue light in the evenings, the greater the delay in melatonin secretion. Delays in melatonin secretion cause problems both in falling asleep and staying asleep. (Gooley et al. 2011.)

One can improve the quality of sleep by creating routines for the evening. Regular bedtimes, minimizing use of stimulants, avoiding heavy meals or exercise at bedtime, are good ways to improve the quality of sleep. The bedroom of a good sleep is dark and cool and there is a comfortable bed. (Walker 2017.) With small, but smart steps it is possible to improve health and fertility, by balancing the hormones with enough good quality sleep.

Here are ten steps that can help to improve healthy sleep habits (Walker 2017; THL 2021):

1. Make time to sleep.
2. Keep a regular sleep rhythm; Go to bed and wake up at the same time every day. Keep it also during weekends.
3. Calm the last 2 hours before bedtime for quiet and relaxing activities, such as reading. Too much blue or artificial light signals the brain to wake up.
4. Avoid heavy meals, exercise, or alcohol too close to bedtime.

5. Avoid nicotine and caffeine in late afternoon or evening. Caffeine has an 5–7-hour half-life, which means that after 7 hours, the body still contains 50 % of the caffeine that was consumed 7 hours ago.
6. Take a hot shower, bath, or sauna in the evening. The drop in temperature after getting out from the heat may help one feel sleepy.
7. Keep the bedroom dark, cool and gadget-free.
8. Enjoy daylight during the day, it will help to regulate daily sleep patterns.
9. If you cannot fall asleep in 15 minutes, get up and do something relaxing, until the sleepiness returns.
10. Instead of a long nap during the day, take a walk outside in the fresh air.

References

Andersen, M. L. & Tufik, S. 2008. The effects of testosterone on sleep and sleep-disordered breathing in men: Its bidirectional interaction with erectile function. *Sleep Medicine Reviews*, 12(5), 365–379.

Cirelli, C., Faraguna, U. & Tononi, G. 2006. Changes in brain gene expression after long-term sleep deprivation. *Journal of Neurochemistry*, 98(5), 1632–1645.

Fogel, R. B., Malhotra, A., Pillar, G., Pittman, S. D., Dunaif, A. & White, D. P. 2001. Increased prevalence of obstructive sleep apnea syndrome in obese women with polycystic ovary syndrome. *The Journal of Clinical Endocrinology & Metabolism*, 86, 1175–1180.

Goldstein, C. A. & Smith, Y. R. 2016. Sleep, circadian rhythms, and fertility. *Current Sleep Medicine Reports*, 2, 206–217.

Gooley, J., Chamberlain, K., Smith, K., Khalsa, S., Rajaratnam, S., Van Reen, E., Zeitzer, J., Czeisler, C. & Lockley, S. 2011. Exposure to room light before bedtime suppresses Melatonin onset and shortens Melatonin duration in humans. *The Journal of Clinical Endocrinology and Metabolism*, 96(3), 463–472.

- Hablitz, L., Vinitzky, H., Sun, Q., Stæger, F., Sigurdsson, B., Mortensen, K., Lilius, T. & Nedergaard, M. 2019. Increased glymphatic influx is correlated with high EEG delta power and low heart rate in mice under anesthesia. *Science Advances*, 5(2), eaav5447 DOI: 10.1126/sciadv.aav5447 <https://advances.sciencemag.org/content/5/2/eaav5447/tab-pdf>
- Hammoud, A. O., Walker, J. M., Gibson, M., Cloward, T. V., Hunt, S. C., Kolotkin, R. L., Adams, T. D. & Meikle, A. W. 2011. Sleep apnea, reproductive hormones and quality of sexual life in severely obese men. *Obesity (Silver Spring)*, 19, 1118–1123.
- Kloss, J. D., Perlis, M. L., Zamzow, J. A., Culnan, E. J. & Gracia, C. R. 2015. Sleep, sleep disturbance, and fertility in women. *Sleep Medicine Reviews*, 22, 78–87.
- Mínguez-Alarcón, L., Souter, I., Williams, P. L., Ford, J. B., Hauser, R., Chavarro, J. E. & Gaskins, A.J. 2017. Occupational factors and markers of ovarian reserve and response among women at a fertility centre. *Occupational and Environmental Medicine*, 74, 426–431.
- Palnitkar, G., Phillips, C. L., Hoyos, C. M., Marren, A. J., Bowman, M. C. & Yee, B. J. 2018. Linking sleep disturbance to idiopathic male infertility. *Sleep Medicine Reviews*, 42, 149–159.
- Reutrakul, S. & Van Cauter, E. 2018. Sleep influences are obesity, insulin resistance, and risk of type 2 diabetes. *Metabolism*, 84, 56–66.
- Rose, R. M., Kreuz, L. E., Holaday, J. W., Sulak, K. J. & Johnson, C. E. 1972. Diurnal variation of plasma testosterone and cortisol. *Journal of Endocrinology*, 54, 177–178.
- Sen, A. & Sellix, M.T. 2016. The circadian timing system and environmental circadian disruption: from follicles to fertility. *Endocrinology*, 157, (9), 3366–3373.
- Spiegel, K., Follenius, M., Simon, C., Saini, J., Ehrhart, J. & Brandenberger, G. 1994. Prolactin secretion and sleep. *Sleep* 17, 20–27.
- THL (Finnish Institute for Health and Welfare) 2021. Sleep and sleep disorders. Available <https://thl.fi/en/web/lifestyles-and-nutrition/sleep-and-sleep-disorders> Read 2.2.2021.
- Walker, M. 2017. *Why we sleep – The new science of sleep and dreams*. Penguin Random House, 1st ed., UK.
- Zhu, J. L., Hjollund, N. H., Boggild, H. & Olsen, J. 2003. Shift work and subfecundity: a causal link or an artefact? *Occupational and Environmental Medicine*, 60, E12.