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Insomnia And Fertility Issues Among Women: A Review Study

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Abstract:
Objective: This study expected to investigate that insomnia is determined by women's health and wellbeing. Especially in terms of fertility. In today's scenario sleep and insomnia can affects women physical, emotional, and psychological health and wellbeing later disturbs fertility among women. Then what would be the degree and what process. This review will show the relation between sleep, insomnia, and women's fertility. The purpose of this review article should be to provide a valuable, authentic information, critical summary of a well-defined area.
Method: We have searched published articles on Google Scholar, Willy, PubMed, Springer and Science Direct from 2000 to 2023 in English to investigate infertility, menstrual health, insomnia, and their effect on infertility. We have searched 6,820 articles. Total 46 papers were finalized. 33 from Google Scholar, 4 from PubMed, 6 from Science Direct, 1 from Springer and 1 from John Wiley.
Result: This evaluation encompassed exclusively descriptive quantitative research that delineated various facets of sexuality within the framework of infertility. The findings indicated that infertility and associated treatment methods for fertilization may result in alterations to sexual self-esteem, sexual relationships, overall welfare, and sexual function.

Conclusion: Insomnia may negatively impact woman's fertility.

Keywords: Sleep, Insomnia, women's fertility, menstrual cycle

I. Introduction:

There is a direct relationship between insomnia and infertility (Carlomagno et al., 2011). Unfortunately, this relationship is largely uncommon (Nicole, 2016). Interestingly, this research is showing insomnia, such a very critical component, may directly affect woman's physical, mental, emotional, psychological health and wellbeing (Baker and Driver, 2007). It is a well-established fact that Insomnia or sleeping disorder is directly associated with innumerable health conditions especially, hormonal imbalance and reproductive problems (Eryilmaz et al., 2011). Does insomnia affect reproductive system? If yes, which type of specific aspects of reproductive capacity are particularly affected? As regards to reproductive capacity, the relevant areas may be fertility, conception, implantation, gestation delivery (Nicole, 2016). The relationship between various reproductive functions could be reciprocal in nature (Shreeve et al., 2013).
Most affirmations related to insomnia and lower reproductive capacity has been common in prolonged stress and its related work or workplaces (Wang et al., 2016). Adverse effects of bad reproductive health are observed through the outcomes such as, menstrual disorders and miscarriage (Shanti and Preumal, 2014). Polycystic ovary syndrome (PCOS) is very common factor in reduction of the reproductive potential (Halis and Arici, 2004). It is believed that PCOS is one of the most common causes of infertility (Pauli et al. 2011). Three studies have shown the relation between sleep disorder and PCOS (Leproult, 2014). One important study established the association between PCOS and sleep disorder which suggested that a person with PCOS were 30 times more likely to suffer from Sleep Disordered Breathing (SDB) than control (Shechter et al., 2008). There is one more similar study which also says that Obstructive Sleep Apnea (OSA) was prevalent in 44% of obese women with PCOS, linked to 6% of age and weight matched reproductively normal subjects (Fogel, 2001).

II. Methods

As the above-mentioned suggest, insomnia can be the main cause of female infertility (Baker and Driver, 2007). This research paper intends to provide information in three stages: firstly, seriousness and prevalence of female infertility will be highlighted; secondly, theoretical, and empirical research support will be presented on the contribution of sleep disorder or insomnia in the path of infertility; thirdly, clinical treatments that increases sleeping pills among infertile women which is responsible for psychological fluctuation among them in later stage (Bracci et al., 2013).

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- Literature Search Strategy: Literature review was done using databases like PubMed, Scopus, and Google Scholar, keywords used (e.g., "insomnia," "sleep disorders," "fertility," "reproductive health," "women's health"), and the time frame of included studies was years 2010 to 2023.
- Inclusion and Exclusion Criteria: Only peer-reviewed studies, studies focused on female participants were included.
- Data Extraction: Cross-sectional, cohort, randomized controlled trials studies and their methodologies were considered.
- Demographics: Age, body mass index (BMI), marital status, and socio-economic background of the participants was gathered. This information is crucial because factors like age and BMI can affect both insomnia and fertility.

III.Background and theoretical Framework of the study

- **Background:**

Insomnia, a prevalent sleep disorder marked by difficulty falling asleep, staying asleep, or experiencing restorative rest, affects millions worldwide and has significant implications for physical and mental health. In women, sleep disturbances are influenced by various life stages and hormonal changes, including menstruation, pregnancy, and menopause, leading to a higher incidence of insomnia compared to men. This sleep disorder, particularly chronic insomnia, disrupts hormonal balance, exacerbates stress, and elevates levels of cortisol and other stress hormones, which can impair reproductive health.

The relationship between insomnia and fertility is complex, as sleep deprivation affects hormonal regulation critical for reproductive health. Studies suggest that chronic insomnia can disrupt the menstrual cycle, affect ovulation, and potentially reduce fertility rates in women. In addition, insomnia is linked with conditions such as polycystic ovarian syndrome (PCOS) and endometriosis, both of which are known to affect fertility. While research has begun to uncover connections between sleep quality and reproductive health, more comprehensive studies are needed to explore the direct and indirect effects of insomnia on fertility.

Given the implications of sleep on reproductive health, understanding insomnia's role in fertility can provide insights into developing preventative and therapeutic interventions for women experiencing fertility challenges related to sleep disturbances.

- **Theoretical framework:**

Biopsychosocial Model of Insomnia and Infertility

This hypothesis posits that infertility resulting from insomnia stems from a complex interaction of biological, psychological, and social variables.

Biological variables encompass hormonal imbalances and physiological reactions linked to sleep problems, such as hypothalamic-pituitary-adrenal (HPA) axis dysregulation and increased cortisol levels, which affect reproductive hormones and disturb menstrual cycles.

Hormonal Dysregulation Theory

This theory posits that insomnia alters the secretion and regulation of key reproductive hormones (e.g., TSH, LH, FSH, PRL, testosterone, estradiol, AMH, progesterone, and melatonin).

Disruptions in these hormones due to sleep disorders may affect follicular development, ovulation, and the menstrual cycle, impacting fertility.

Stress Response Theory

Insomnia may act as a chronic stressor that activates the body's "fight-or-flight" response. Chronic stress from poor sleep elevates cortisol levels, influencing reproductive health.

This prolonged stress response can cause further sleep disruptions, creating a feedback loop where insomnia and stress mutually reinforce each other, compounding effects on fertility.

Impact of Lifestyle and Environmental Factors

This framework considers how modern lifestyle factors, such as night shifts and urban living, contribute to insomnia and influence fertility.

Environmental stressors and work-related sleep disturbances can trigger or exacerbate hormonal disruptions, linking lifestyle factors to infertility.

Psychosocial Implications of Infertility and Insomnia

Infertility can lead to psychological strain, which may further affect sleep quality, creating a cyclical impact where insomnia and infertility are interlinked.

Psychological impacts, such as anxiety, depression, and emotional stress due to infertility, may reinforce insomnia, contributing to the persistence of both conditions.

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Hypothesis: Each of these theoretical perspectives supports the hypothesis that insomnia, through various pathways, could be a significant contributing factor to infertility among women. This framework provides a basis for analyzing empirical data on how sleep disturbances directly and indirectly impact reproductive health and can be explored in relation to treatment interventions.

IV. Results:

Infertility: Globally, the cases of infertility have been rapidly increased in recent years. According to the American Society for Reproductive Medicine (2014), infertility is a disease which is related to the male or female reproductive system (Kloss et al., 2014). Infertility is diagnosed when a couple are unable to achieve pregnancy even after 12 months or more of regular unprotected sexual intercourse. There may be multiple factors associated with infertility (Gurunath, 2011).

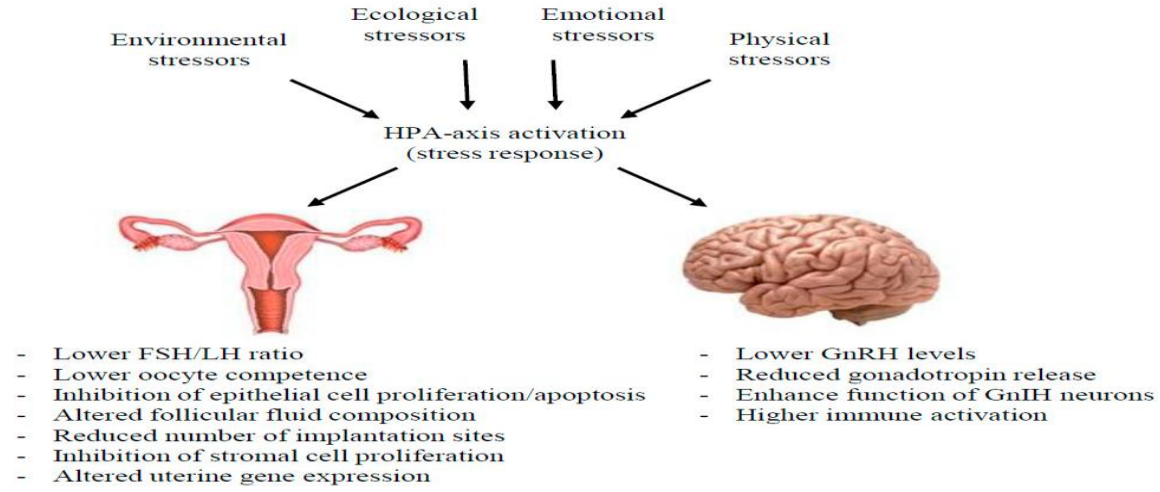
The study on pregnancy and infertility have shown that 1 in 8 couples (or 12% of married women) are facing trouble in getting pregnant or sustaining pregnancy (Davis et al., 2012). Infertility has been a big issue for many women, which is mostly triggered by modern day lifestyle (Vgontzas et al., 2001). In urban areas, it has been enormously spreading day by day among women from different cultures and societies from all over the world (Shradha, 2019). Although it is a very common and a serious problem, there is no definite treatment for this disease and researches are going on but no conclusive results are available till now (Touzet et al., 2002). According to the American Society of Reproductive Medicine (2012), infertility can be diagnosed by the failure to get pregnant even after 12 months or more of regular unprotected sexual intercourse (Practice, 2012). Medical histories based on earlier evaluation and treatment after 6 months of over the age of 35 years, may be considered infertility problems (Naina, 2010).

The American Society for Reproductive Medicine (2012) says that it is a kind of disease which directly affects quality of life issues (Unfer et al., 2011). Moreover, the American Court says that those conditions which hinder the reproduction process should be considered as a disability (Disability Act 2012). Court says ahead that infertility itself creates fundamental challenges to one's emotional and social well-being to (Nitsche, 2010).

Causes of Infertility: Infertility may be the result of organic diseases (anovulation, tubal obstruction), iatrogenic diseases (side effects of chemotherapy) and lifestyle diseases (weight, occupation) (Birketvedt et al., 2012). The psychological stress among infertile women may be contributing to the expansion of infertility problems (Irwin, 2003).

Relationship between sleep disorder (insomnia) and infertility:

This research paper has mentioned both; a fusion of literature related to sleep disorder and reproductive system with a scientific evaluation about the sleep disorder and its interference with infertility. According to literature review, regular fluctuation of sleep duration and timings may itself disturbs the reproduction process through hyper activation of Hypothalamic Pituitary Adrenal Axis (HPA) and circadian rhythms (Sengupta, 2012). Later, it may cause infertility (Figure 1).



(Source: Joseph and Whirledge, 2017) https://doi.org/10.3390/ijms18102224

Figure 1: This model has focused on sleeping disorders that disturbs the reproduction like, early pregnancy losses, menstrual problems, anovulation and so on. As gonadal hormones and gonadotropic hormones may be helpful in circadian rhythms, they may fluctuate because of sleep disorder. Sleep and circadian disorders are the result of glucose intolerance and insulin resistance. Hence, it may disturb reproduction. Elevated hypothalamic-pituitary-adrenal axis (HPA) and increased sympathetic nervous system activity along with prolonged oxidative stress can create hurdles in the pathway of conception. It has been seen as very common in workers with shifting duty.

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Here, three points can be highlighted: First, fluctuation in the function of the HPA axis can affect reproductive hormones (Birketvedt et al., 2012). This can interfere with normal follicle development, menstruation, and fertility. Second, excessive physical activity and lack of relaxation causes stress (Joseph and Whirledge, 2017), which may affect reproductive organs such as ovaries, endometrium. Third, prolonged stress may also affect conception (Ibrahim et al. 2023). In brief, prolonged stress has the capacity to harm fertility with its associated factors such as menstruation cycle, implantation, and placental growth. (Dubola et al., 2021).

V. Discussion:

Chronic insomnia's etiology is normally acknowledged as a disorder of hyperarousal (fight or flight condition) which is associated with psychological and biological factors (Hollander et al., 2001). At the psychological level, regular stress and according to those behavioural practices can make that disorder more chronic (Richardson and Wang-Weigand 2009). At the biological level, autonomic hyperactivation includes unusual neuroendocrine responses (Dubola et al., 2021). Moreover, elevated stress in chronic insomnia patients releases corticotropin-releasing hormone (CRH) and cortisol, which triggers the activation of the HPA axis (Cathy et al., 2016). However, the activation of the HPA axis and hypersecretion of stress related neurohormones can be the result of chronic insomnia (Dubola et al., 2021). It may result in arousal and more sleep disorder. Hence, it is possible that fertility can be affected by prolonged stress (Nakamura et al., 2008). Now, it should come as no surprise that there is correlation between insomnia and fertility. Insomnia may disturb the reparation and amplification of reproductive hormones for successful conception (Wang et al., 2020).

Thyroids Stimulating Hormone (TSH): - Increased level of TSH indicates hypothyroidism. It can cause anovulation, frequent miscarriages, amenorrhea, and irregular menstruation. Moreover, high levels of TSH can also raise prolactin (PRL), this thing may also lead to infertility (Kang et al., 2018). One study shows that TSH level is high before sleep and constantly increases during night or sleeping period. Gradually, it decreases during the day time (Rani et al., 2021). During insomnia TSH level constantly decreases. For example, TSH level is remarkably increased due to the fluctuation of sleep in the follicular phase of healthy women. Similarly, insomnia is associated with the high level of TSH (Rani et al., 2021).

Luteinizing Hormone (LH): - Elevated luteinizing hormone may disturb reproduction (Wang et al., 2020). As LH plays a key role at the beginning of menstruation therefore sleep disturbance can disturb its functions (Unuane et al., 2011). There is evidence available which says that insomnia badly affects LH secretion in the early follicular phase and its related functions. Sleep disorder also disturbs the pulse repetition frequency (PRF) (Wang et al., 2020). Later, this prolonged situation also decreases the frequency of PRF during the mid-follicular phase (Merklinger-Gruchala et al., 2008).

Follicular Stimulating Hormone (FSH): - During the early follicular phase high FSH level is a pointer of low ovarian reserve (Dubola et al., 2021). Unusually, low FSH level can show dysfunctioning of hypothalamus or pituitary which shows irregular cycle or amenorrhea (Goldstein and Smith 2016). Thus, it may cause low follicular phase which also may cause luteal phase dysfunctioning. Normally, this thing represents a short luteal phase (Weiss and Clapauch, 2013).

Prolactin (PRL): - Pituitary gland secretes prolactin hormone. In women it is responsible for the reproduction and lactation (Vgontzas et al., 2001). There is evidence that hyperprolactinemia is responsible for anovulation, PCOS and endometriosis (Weiss and Clapauch, 2013). PRL level is at its peak at night. Therefore, insomnia suppress it profoundly (Acevedo-Rodriguez et al., 2018). Those who have night eating syndrome have increased PRL level which is assumed to show a stress regulatory response to cortisol (Rotenberg and McGrath, 2016). One study has said that sleep inducing medications also causes hypersecretion of PRL (Goldstein and Smith, 2016). In brief, sleeping disorder or insomnia may fluctuate PRL secretion. In that way it may lead to hormonal disbalance (Pacchiarotti et al., 2016).

Testosterone: - It is usually low in the healthy reproductive age women. It works as a follicular regulator. This is why PCOS problems can explain the relationship between elevated testosterone and fertility problems (Mahoney and Mong, 2010). Therefore, hyper-androgenism may be linked with PCOS because it is responsible for conception and consequently infertility. As testosterone is secreted in men and women both, but mainly been studied in men. In men testosterone level correlates with sleep pattern certainly for body fat, activity level and age control (Mahoney and Mong, 2010). One study has found that lower baseline testosterone levels are usually linked with longer wake after sleep onset (WASO) during menopause. Remarkably, elevated testosterone levels have been found in women with PCOS and they are prone for developing sleep Apnea (Layback et al., 2001).

Estradiol: - It is secreted through the granulosa cells from the ovarian follicles. It regulates FSH and LH along with ovulation (Fogel, et al., 2001). Due to the fluctuation of estradiol, FSH and LH becomes passive and thereby may cause anovulation problem. Although many studies have been showing the declining level of estrogen in middle age and aging women because of sleep disturbance (Thiyararajan and Basit, 2022). The level of estradiol is 60% lower among right sleep pattern women instead of women with erratic sleep patterns. Elevated estradiol level is also related to insomnia or poor sleep pattern (Demorrow, 2018).

Anti- Mullerian Hormone (AMH): - It plays a key role in ovarian reserve. There has been very little study on AMH and sleep disorder (Knutsson, 2004). One research has been found on this topic which measured a single item "do you experience disturbed sleep?" (Andersen et al., 2011). Testosterone, sleep, and sexual function in men and women are associated. Brain research, 1416, 80-104.). A decrease in estrogen and testosterone hormones may relate to this relationship. (Sowers, 2008). On the other hand, the anxiety and anxiousness among women may be responsible for sleep disturbance along with low ovarian reserve (Macrea et al., 2010).

Progesterone: - It is related to luteal phase and a key player for implantation and maintenance of pregnancy (Macrea et al., 2010). Unusually, be the decreased progesterone level may major factor of luteal phase dysfunction (Rotenberg and McGrath, 2016). It has been well documented that progesterone has a direct relation with sleep (Pacchiarotti et al., 2016). So far, their effects on each other are limited. Declined levels of progesterone may cause sleep disorder among general and PCOS women (Osswaaarde et al., 2011).
Melatonin: - It is a key hormone which secretes often. It accompanied women's fertility. As reviewed by one report, the elevated level of melatonin is related to amenorrhea and hypothalamic-pituitary-gonadal axis (Demorrow, 2018). Another study has found that melatonin was advertised as a contraceptive for ovulation (Tandon and Yadav, 2020). However, there is a study on night shift workers and non-shift workers, saying that night shift workers have decreased melatonin levels along with elevated LH and FSH levels (Layback et al., 2001). One study is also saying that melatonin works as a key player accompanied with GnRH to magnify the effect of LH and FSH at the follicular level but not the luteal phase (Herbert et al., 2010). This thing indicates that melatonin's effects may vary on the menstrual cycle phase (Stevens, 2006).

VI. Limitations

- Methodological Limitations: A few limitations in the studies reviewed were,
  - small sample sizes,
  - observational designs, and
  - lack of control for confounding variables.
- Gaps in the Literature: Points of areas that lack sufficient research, are the impact of different chronic and acute insomnia and insomnia specific yogic interventions on fertility outcomes.
- Review Limitations: A potential selection bias on the available literature could be specific to this review, is likely.

VII. Suggestions for Future Research:

- Longitudinal studies on insomnia and fertility in the rural areas and people who are below poverty line need to be conducted
- Randomized controlled trials of yogic interventions that are specific to sleep disorders, and comparison of investigations into the effects of insomnia severity can be carried out for a more comprehensive analysis.

VIII. Conclusion:

There are various evidences that shows sleep quantity or quality, abnormal sleep or disorders may fluctuate the number of various reproductive hormones. The harmony between these reproductive hormones is necessary for the successful ovulation, conception, and implantation. Addressing sleep issues for women's reproductive health at an early stage through yoga-nidra and other effective meditation techniques is important. Besides, more awareness of sleep health in reproductive-aged women and the potential benefits of integrating sleep management into fertility care is the need of the hour.

Conflict of interest:
None

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IX. References:

1. Acevedo-Rodriguez, A., Kauffman, A.S., Cherrington, B.D., Borges, C.S., Roepke, T.A., and Laconi, M. (2018): Emerging insights into hypothalamic-pituitary-gonadal axis regulation and interaction with stress signalling. *Journal of neuroendocrinology*, *30*(10), e12590. http://doi.org/10.1111/jne.12590
2. Andersen, M.L., Alvarenga, T.F., Mazaro-Costa, R., Hachul, H.C., and Tufik, S. (2011): The association of testosterone, sleep, and sexual function in men and women. *Brain research, 1416*, 80-104. https://doi.org.10.1016/j.brainres.2011.07.060
3. Baker, F.C., and Driver, H.S. (2007): Circadian rhythms, sleep, and the menstrual cycle. *Sleep medicine, 8*(6), 613-622. https://doi.org/10.1016/j.sleep.2006.09.011
4. Birketvedt, G.S., Geliebter, A., Kristiansen, I., Firgenschau, Y., Goll, R., and Florholmen, J.R. (2012): Diurnal secretion of ghrelin, growth hormone, insulin binding proteins, and prolactin in normal weight and overweight subjects with and without the night eating syndrome. *Appetite*, *59*(3), 688–692. https://doi.org/10.1016/j.appet.2012.07.015
5. Bracci, M., Copertaro, A., Manzella, N., Staffolani, S., Strafella, E., Nocchi, L., Barbaresi, M., Copertaro, B., Rapisarda, V., Valentino, M., and Santarelli, L. (2013): Influence of night-shift and napping at work on urinary

melatonin, 17-β-estradiol and clock gene expression in pre-menopausal nurses. *Journal of biological regulators and homeostatic agents*, *27*(1), 267–274. PMID: 23489707

6. Carlomagno, G., Nordio, M., Chiu, T.T., and Unfer, V. (2011): Contribution of myo-inositol and melatonin to human reproduction. *European Journal of Obstetrics & Gynecology and Reproductive Biology*, *159*(2), 267-272. https://doi.org/10.1016/j.ejogrb.2011.07.038
7. Davis, S., Mirick, D.K., Chen, C., and Stanczyk, F.Z. (2012): Night shift work and hormone levels in women. *Cancer epidemiology, biomarkers & prevention*, *21*(4), 609-618. https://doi.org/10.1158/1055-9965.EPI-11-1128
8. Demorrow, S. (2018): Role of the hypothalamic-pituitary-adrenal axis in health and disease, *International journal of molecular science*, *19*(40), 986. htpp://doi.org/10.3390/ijms19040986
9. Dubol, M., Epperson, C.N., Sacher, J., Pletzer, B., Derntl, B., Lanzenberger, R., ... and Comasco, E. (2021): Neuroimaging the menstrual cycle: a multimodal systematic review. *Frontiers in neuroendocrinology*, *60*, 100878. https//doi.org/10.1016/j.yfrne.2020.100878
10. Eryilmaz, O.G., Devran, A., Sarikaya, E., Aksakal, F.N., Mollamahmutoğlu, L., and Cicek, N. (2011): Melatonin improves the oocyte and the embryo in IVF patients with sleep disturbances, but does not improve the sleeping problems. *Journal of assisted reproduction and genetics*, *28*, 815-820. https://doi.org/10.1007/s10815-011-9604-y
11. Fogel, R.B., Malhotra, A., Pillar, G., Pittman, S.D., Dunaif, A., and 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*(3), 1175-1180. https://doi.org/10.1210/jcem.86.3.7316
12. Goh, V.H.H., and Tong, T.Y.Y. (2010). Sleep, sex steroid hormones, sexual activities, and aging in Asian men. *Journal of andrology*, *31*(2), 131-137.
13. Goldstein, C.A., and Smith, Y.R. (2016): Sleep, circadian rhythms, and fertility. *Current Sleep Medicine Reports*, *2*, 206-217. https://doi.org/10.1007/s40675-016-0057-9
14. Gurunath, S., Pandian, Z., Anderson, R.A., and Bhattacharya, S. (2011): Defining infertility—a systematic review of prevalence studies. *Human reproduction update*, *17*(5), 575-588. https://doi.org/10.1093/humupd/dmr015.
15. Halis, G., and Arici, A. (2004): Endometriosis and inflammation in infertility. *Annals of the New York Academy of Sciences*, *1034*(1), 300-315. https://doi.org/10.1196/annals.1335.032
16. Herbert, D.L., Lucke, J.C., and Dobson, A.J. (2010): Early users of fertility treatment with hormones and IVF: women who live in major cities and have private health insurance. *Australian and New Zealand Journal of Public Health*, *34*(6), 629–634. https://doi.org/10.1111/j.1753-6405.2010.00625.x
17. Hollander, L.E., Freeman, E.W., Sammel, M.D., Berlin, J.A., Grisso, J.A., and Battistini, M. (2001): Sleep quality, estradiol levels, and behavioral factors in late reproductive age women. *Obstetrics and gynecology*, *98*(3), 391–397. https://doi.org/10.1016/s0029-7844(01)01485-5
18. Irwin, M. Clark, C. Kennady, B. Gillin, C, Ziegler, M. (2003): Nocturnal catecholamines & immune function in insomniacs, depressed patients & control subjects. *Brain, behaviour & immunity*. *17*(5), 365-372. https://doi.org/10.1016/S0889-1591(03)00031-X
19. Joseph, D.N., and Whirledge, S. (2017): Stress and the HPA Axis: Balancing Homeostasis and Fertility. *International journal of molecular sciences*, *18*(10), 2224. https://doi.org/10.3390/ijms18102224
20. Kang, W., Jang, K.H., Lim, H.M., Ahn, J.S., and Park, W.J. (2019): The menstrual cycle associated with insomnia in newly employed nurses performing shift work: a 12-month follow-up study. *International archives of occupational and environmental health*, *92*, 227-235. https://doi.org/10.1007/s00420-018-1371-y
21. Kloss, J.D., Perlis, M.L., Zamzow, J.A., Culnan, E.J., and Gracia, C.R. (2015): Sleep, sleep disturbance, and fertility in women. *Sleep medicine reviews*, *22*, 78–87. https://doi.org/10.1016/j.smrv.2014.10.005
22. Knutsson, A. (2004): Methodological aspects of shift-work research. *Chronobiology international*, *21*(6), 1037-1047. https://doi.org/10.1081/CBI-200038525
23. Layback, S. Lava, S. Turek, F. and Zee, P. (2001): Effects of shift work on sleep and menstrual function in nurses, *Health care for women international*, *23*, 703-714, https://doi.org/10.1080/07399330290107449
24. Leproult, R., Holmbäck, U., and Van Cauter, E. (2014): Circadian misalignment augments markers of insulin resistance and inflammation, independently of sleep loss. *Diabetes*, *63*(6), 1860-1869. 1860–1869. https://doi.org/10.2337/db13-1546
25. Macrea, M.M., Martin, T.J., and Zagrean, L. (2010): Infertility and obstructive sleep apnea: the effect of continuous positive airway pressure therapy on serum prolactin levels. *Sleep & breathing = Schlaf & Atmung*, *14*(3), 253–257.
26. https://doi.org/10.1007/s11325-010-0373-0
27. Mahoney, M.M. (2010): Shift work, jet lag, and female reproduction. *International journal of endocrinology*, 2010. https://doi.org/10.1155/2010/813764
28. Merklinger-Gruchala, A., Ellison, P.T., Lipson, S.F., Thune, I., and Jasienska, G. (2008): Low estradiol levels in women of reproductive age having low sleep variation. *European journal of cancer prevention: the official journal of the European Cancer Prevention Organisation (ECP)*, *17*(5), 467–472. https://doi.org/10.1097/CEJ.0b013e3282f75f67

29. Naina, P. and Himani, S. (2021): Prevalence & potential determinants of primary infertility in India: Evidence from India demographic health survey. *Clinical epidemiology & global health*, *9*, 162-170, https://doi.org/10.1016/j.cegh.2020.08.008
30. Nakamura, K. Sheps, S. and Clara arck, P. (2008): Stress and reproductive failure: past notions, present insights and future directions. *Journal of assisted reproduction and genetics*, *25*(2-3), 47-62. https://doi.org/ 10.1007/s10815-008-9206-5
31. Nitsche, K. and Eharmann, A., D. (2010): Obstructive Sleep Apnea and Metabolic Dysfunctioning Polycystic Ovary Syndrome, *Best practice & research endocrinology and metabolism*, *24*(5), 717-730. https://doi.org/10.1016/j.beem.2010.08.001
32. Ossewaarde, L., van Wingen, G.A., Rijpkema, M., Bäckström, T., Hermans, E.J., and Fernández, G. (2013): Menstrual cycle-related changes in amygdala morphology are associated with changes in stress sensitivity. *Human brain mapping*, *34*(5), 1187-1193. https://doi.org/10.1002/hbm.21502
33. Pacchiarotti, A., Carlomagno, G., Antonini, G., and Pacchiarotti, A. (2016): Effect of myo-inositol and melatonin versus myo-inositol, in a randomized controlled trial, for improving in vitro fertilization of patients with polycystic ovarian syndrome. *Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology*, *32*(1), 69–73. https://doi.org/10.3109/09513590.2015.1101444
34. Pauli, J.M., Raja-Khan, N.,Wu,X., and Legro, R.S. (2011): Current perspectives of insulin resistance and polycystic ovary syndrome. *Diabetic Medicine, 28*(12), 1445-1454. https://doi.org/10.1111/j.1464-5491.2011.03460.x
35. Practice Committee of the American Society for Reproductive Medicine. (2012): The clinical relevance of luteal phase deficiency: a committee opinion. *Fertility and sterility*, *98*(5), 1112-1117. https://doi.org/10.1016/j.fertnstert.2012.06.050
36. Rani, S. Maharana, S. Metri, K., G. Bhargav, H., and Nagaratna, R. (2021): Effect of yoga on depression in hypothyroidism: A pilot study. *Journal of traditional and complementary medicine*, *11*(4), 375-380. https://doi.org/10.1016/j.jtcme.2021.01.001
37. Richardson, G., and Wang-Weigand, S. (2009): Effects of long-term exposure to ramelteon, a melatonin receptor agonist, on endocrine function in adults with chronic insomnia. *Human psychopharmacology*, *24*(2), 103–111. https://doi.org/10.1002/hup.993
38. Rotenberg, S., and McGrath, J.J. (2016): Inter-related between autonomic & HPA axis activity in childern and adolescents. *Biological psychology*, *117*, 16-25, https://doi.org/10.1016/j.biopsycho.2016.01.015
39. Sengupta, P. (2012): Challenge of Infertility: How protective the Yoga Therapy is? *Anc sci life*, *32*(1), 61-62. http://doi.org/ 10.4103/0257-7941.113796
40. Shanti, S., and Preumal, K. (2014): Kayakalpa yoga, A treasure hunt for women with PCOS and infertility: A pilot trial. research & reviews. *A journal of unani, siddha and homeopathy*, *1*(3), 12-23, ISSN: 2394-1960.
41. Shechter, A., James, F.O., and Boivin, D.B. (2008). Circadian rhythms and shift working women. *Sleep medicine clinics*, *3*(1), 13-24. https://doi.org.10.1016/j.jsmc.2007.10.008
42. Shradha, S., P. Prachi, P., and Valeria, B. (2019): Reproductive, Maternal, New born, Child and Adolescent health & related behavior change communication strategies Bangladesh, Nepal and India: A narrative review. *Clinical epidemiology and global health*, *8*(1), 280-286. https://doi.org/10,10.1016/j.cegh.2019.08.014
43. Shreeve, N., Cagampang, F., Sadek, K., Tolhurst, M., Houldey, A., Hill, C. M., ... and Cheong, Y. (2013): Poor sleep in PCOS; is melatonin the culprit. *Hum Reprod*, *28*(5), 1348-1353. https://doi.org/10.1093/humrep/det013
44. Sowers, M. F., Zheng, H., Kravitz, H. M., Matthews, K., Bromberger, J. T., Gold, E. B. and Hall, M. (2008): Sex steroid hormone profiles are related to sleep measures from polysomnography and the Pittsburgh Sleep Quality Index. *Sleep*, *31*(10), 1339-1349. PMCID: PMC2572739
45. Stevens, R.G. (2006): Artificial lighting in the industrialized world: circadian disruption and breast cancer. *Cancer Causes & Control*, *17*(4), 501-507. http://dx.doi.org 10.1007/s10552-005-9001-x
46. Tandon, N. and Yadav, S.S. (2020): Safety and clinical effectiveness of Withania Somnifera (Linn.) Dunal root in human ailments. *Journal of ethnopharmacology*, *255*, 112768. http://dio.org/ 10.1016/j.jep.2020.112768
47. Thiyararajan, D., Basit, H. and Jeanmonod, R. (2022): Physiology, Menstrual Cycle, *Treasure Island (FL): Starpearls publishing*, http://www.ncbi.nIm. nih.gov/books/NBK500020
48. Touzet, S., Rabilloud, M., Boehringer, H., Barranco, E., and Ecochard, R. (2002): Relationship between sleep and secretion of gonadotropin and ovarian hormones in women with normal cycles. *Fertility and sterility*, *77*(4), 738-744. https://doi.org/10.1016/s0015-0282(01)03254-x
49. Unfer, V., Raffone, E., Rizzo, P., and Buffo, S. (2011): Effect of a supplementation with myo-inositol plus melatonin on oocyte quality in women who failed to conceive in previous in vitro fertilization cycles for poor oocyte quality: a prospective, longitudinal, cohort study. *Gynecological Endocrinology*, *27*(11), 857-861. https://doi.org.10.3109/09513590.2011.564687
50. Unuane, D. Tournaye, H. Velkeniers, B. and Poppe, K. (2011): Endocrine disorder and female infertility, *Elescier Ltd*. https//doi.org/10.1016/j.beem.2011.08.001

51. Vgontzas, A.N., Legro, R.S., Bixler, E.O., Grayev, A., Kales, A., and Chrousos, G.P. (2001): Polycystic ovary syndrome is associated with obstructive sleep apnea and daytime sleepiness: role of insulin resistance. *The Journal of Clinical Endocrinology & Metabolism*, *86*(2), 517-520. https://doi.org/10.1210/jcem.86.2.7185
52. Wang, C., Liu, Y., Dun, W., Zhang, T., Yang, J., Wang, K., ... and Liu, J. (2021): Effects of repeated menstrual pain on empathic neural responses in women with primary dysmenorrhea across the menstrual cycle. *Human Brain Mapping*, *42*(2), 345-356. https://doi.org/10.1002/hbm.25226
53. Ibrahim, S., Mehra, R., Tantibhedhyangkul, J., Bena, J., & Flyckt, R. L. (2023). Sleep and obstructive sleep apnea in women with infertility. Sleep and Breathing, 1-10. https://doi.org/10.1007/s11325-022-02770-4
54. Wang, Y., Gu, F., Deng, M., Guo, L., Lu, C., Zhou, C. and Xu, Y. (2016): Rotating shift work and menstrual characteristics in a cohort of Chinese nurses. *BMC women's health, 16*(1), 1-9. https://doi.org/10.1186/s12905-016-0301-y
55. Weiss, V.R. and Clapauch, R. (2013): Female infertility of endocrine origin, *Arquivos brasileiros de endocrinologia and metabologia*, *58*(2), 144-152. https//doi.org/10.1590/00042-730000003021
56. White, N.D. (2016): Influence of sleep on fertility in women. *American journal of lifestyle medicine*, *10*(4), 239-241. https://doi.org/10.1177/1559827616641386s