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Review Article

Review on the Impact of Android Mobile Phone-Emitted Blue Light and Electromagnetic Radiation on Hormonal Homeostasis Category: Review Article

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Abstract

Android mobile phone has become an essential part of the modern lifestyle due to communication, information access, online work, entertainment, navigation, shopping, and even learning etc. Electromagnetic radiation (EMR), especially blue light emitted from android mobiles, has become the main concern for eyesight and hormonal imbalance in particular. This review aims to explore the mechanisms through which mobile light, EMR, and digital overstimulation may contribute to hormonal imbalance especially sex hormone, stress hormone, sleep regulation and digestive dysfunction; and a discussion thereby for health care by maintaining balanced digital habits. Research could explore the underlying mechanisms and long-term health implications of such light-induced hormonal dysregulation.

Keywords: Android Mobile; Electromagnetic Radiation (EMR); Blue Light; Hormonal Imbalance; Hormonal Dysregulation

Introduction

The rapid expansion of android mobile phone usage has increased daily exposure to artificial light, electromagnetic radiation, and continuous web-based engagement. EMR (electromagnetic radiation) is the propagation of energy through space or matter in the form of electromagnetic waves or photons [1,2]. It does not require a medium to travel. Blue light is a part of visible light with a wavelength between 400–490 nanometers. It has higher energy and shorter wavelength compared to other visible colours. Sources of this kind of radiation are mobile phones, laptops, tablets, computers, TVs, Wi-Fi routers, microwave ovens, power lines, LED lights etc. [3,4]. In recent years, the extensive use of Android mobile phones and continuous exposure to digital screens have raised significant concerns regarding their impact on human physiology. Modern Android mobile phones emit blue light and electromagnetic radiation that can interfere with the body's natural biological rhythms. These external stimuli have the potential to disrupt hormonal regulation, particularly melatonin, cortisol, and even sex hormones, which depend on a stable circadian pattern for proper secretion. Disturbances in these hormones may indirectly influence metabolic functions, enzyme activity, impacting digestion, appetite control, and overall gastrointestinal function. Moreover, prolonged engagement with web-based content, late-night screen usage, and excessive digital dependence contribute to sleep deprivation, stress responses, and altered neuroendocrine functioning. As a result, researchers have begun to explore how mobile radiation, blue light exposure, and behavioural patterns

associated with mobile usage may collectively influence hormonal balance and digestive processes [5-9].

EMR (electromagnetic radiation) and blue light

Electromagnetic rays are formed of energy that travels in waves and include a wide spectrum ranging from radio waves to gamma rays, which is depicted in Figure 1. Among them, visible light is a small portion that the human eye can detect [10,11]. Blue light, a high-energy visible (HEV) light with wavelengths ranging about in between 380 to 500 nanometers, depending on the devices, is a significant component emitted from digital screens such as smart phones, computers, and LED lights [12,13]. Continuous exposure to blue light, especially from web browsing and prolonged screen use, has raised major concerns regarding its biological and psychological effects. Blue light penetrates deeply into the eye and may contribute to retinal stress, visual fatigue, and digital eye strain, a condition often referred to as Computer Vision Syndrome. Blue light exposure, particularly during night-time can suppress melatonin secretion, disrupt circadian rhythm, and impair sleep quality. Long and intense exposure may also contribute to digital eye strain, headaches, and reduced blink rate, which can cause dryness and visual fatigue. As mobile usage increases, artificial blue-light exposure has become a major environmental factor affecting hormonal balance and sleep architecture [14].

Android devices also emit radiofrequency electromagnetic radiation (RF-EMFs) during cellular communication, Wi-Fi, Bluetooth, hotspot use, and data transfer. These EMRs are non-ionizing but interact with biological tissues through thermal and non-thermal mechanisms. Although regulated by SAR (Specific Absorption Rate) limits, prolonged close-range exposure (such as holding the phone near the head or body) may influence neural activity, stress-response pathways, and hormonal regulation. EMF exposure is also associated with oxidative stress, altered enzyme activity, and potential impacts on sleep physiology [15,16].

Impact of android devices on different age groups

In the last decade, the rapid growth of android mobile phones and easy access to the internet have dramatically increased daily screen time across all age groups. Android mobile phones and the web have become an essential part of modern life, offering communication, entertainment, education, navigation, and social interaction in a single device. With the expansion of 4G/5G networks,

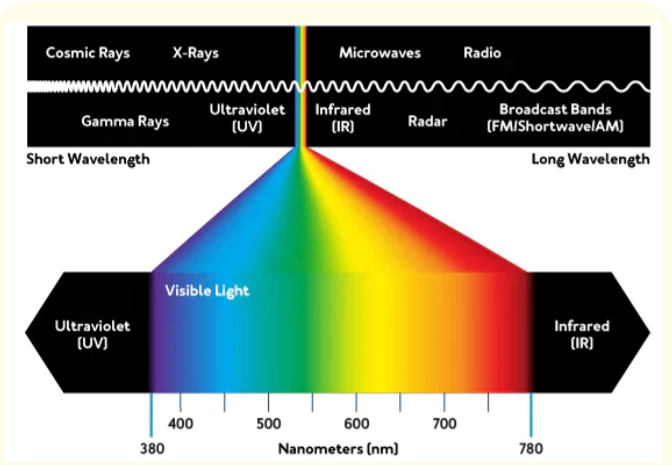

Figure 1: Electromagnetic Spectrum.

affordable data plans, and the rise of social media platforms, people are spending significantly more hours on mobile screens than ever before. This continuous connectivity has also increased exposure to digital content, blue light, and electromagnetic radiation [17,18].

Studies worldwide reveal that more than 70% of adults report sleep disturbances, eye strain, and mental fatigue due to prolonged screen exposure. Among children, early and long-term use of mobile devices is linked to reduced attention span, impaired cognitive development, and behavioral issues, with about 60% of children experiencing eye discomfort or headaches from screen use. The global studies have linked excessive web and mobile use to sedentary lifestyles, obesity, and metabolic disorders across all age groups. The radiation emitted by mobile devices, though low in intensity, may contribute cumulatively to cellular stress and oxidative damage, particularly with long-term exposure [19,20]. The psychological impact is equally alarming, with rising cases of screen addiction, loneliness, and decreased social interaction. Worldwide data indicate that the average screen time has crossed 6 to 8 hours per day in most populations, with children being exposed as early as two years of age, resulting in developmental and vision-related complications. Hence, the collective effect of mobile light, radiations, and excessive web dependency has become a multifaceted public health challenge, necessitating global awareness, responsible technology use, and the promotion of digital well-being among all age groups [21]. The excessive exposure to android mobile light, radiations, and web usage has

emerged as a serious global health concern affecting adults, elderly people, and children alike. The blue light emitted from mobile screens interferes with melatonin secretion, a hormone essential for regulating the sleep wake cycle, leading to sleep disorders, fatigue, and hormonal imbalance. Among children and adolescents, prolonged exposure to mobile light contributes to reduced attention span, impaired academic performance, and behavioural changes due to overstimulation of the nervous system. In adults, continuous mobile usage results in digital eye strain, headaches, anxiety, and even increased stress levels caused by constant social media engagement and information overload. The elderly population faces unique risks such as worsened vision, disruption of circadian rhythm, and cognitive decline due to reduced sleep quality and prolonged exposure to electromagnetic radiations [22].

Impact on sex hormones

Hormonal balance in males plays a vital role in maintaining fertility. Different studies showed a significant decrease in the level of FSH and LH in male rats exposed to cell phone radiations. The pituitary gland produces luteinizing hormone (LH) and follicle stimulating hormone(FSH) that regulate reproduction in males. LH stimulates testosterone production from the interstitial cells of the testes (Leydig cells). FSH stimulates testicular growth and enhances the production of an androgen binding protein by Sertoli cells, which are components of the testicular tubule necessary for sustaining the maturing sperm [23]. EMR provokes oxidative stress which induces significant decrease in FSH and LH. The decreased level of gonadotropin (FSH and LH) could be a factor in the decrease of sperm numbers and associated parameters [24-26].

EMR also shows an effect on testicular tissue. The testis is surrounded by a capsule and contains septa. Spermatids are arranged peripherally and develop into spermatozoa, mature sperms in the tubule lumen, and dense coelom formation in the testes lumen. The results of the microscopic examination showed that the degeneration of the seminiferous tubules and lack of spermatozoa, as well as some spermatogenic cells due to the exposure of EMR. There is a considerable rise in the width of the seminiferous tubules, fibrosis of the interstitial tissue, and a lack of ledige cells in the exposed tissue compared to the normal unexposed testicular tissue [27,28]. A pictorial presentation is followed in Figure 2.

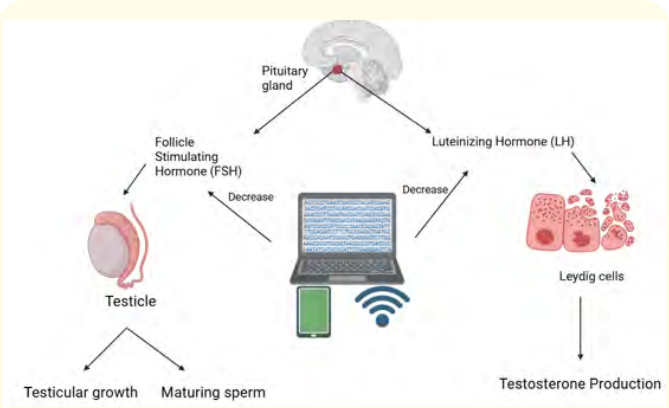

Figure 2: Effect on male fertility.

Ovary contains a number of developing follicles, Graafian follicles, Corpora lutea and few atretic follicles along with stroma interstitial. Due to the exposure of EMR, the total number of healthy follicles (excluding the primordial and atretic follicles) is decreased followed by less number of developing and Graafian follicles and few corpus lutea. The thickness of endometrium as well as myometrium are also decreased [25,26].

Impact on stress hormones

Continuous exposure to mobile radiation and cognitive overload from digital content activates the HPA (hypothalamic-pituitary-adrenal) axis.[29] The hypothalamus releases Corticotropin-Releasing Hormone (CRH). CRH stimulates the pituitary to release Adrenocorticotropic Hormone (ACTH). ACTH signals the adrenal glands to produce cortisol, the primary stress hormone [31,32]. Engaging with social media, work notifications, or emotionally charged content triggers cognitive and emotional pathways. Continuous web-content exposure activates Amygdala (fear–stress center) and Prefrontal cortex overload. This leads to hyperarousal, anxiety, increased stress-hormone release [32]. Stimulation of stress hormone production is expressed in Figure 3.

Impact on sleep hormone (melatonin)

Melatonin is a hormone secreted mainly by the pineal gland in the brain. It regulates the sleep-wake cycle, at high level promotes sleep, while low levels promote wakefulness. Under normal conditions, melatonin, a hormone secreted by the pineal gland, increases in

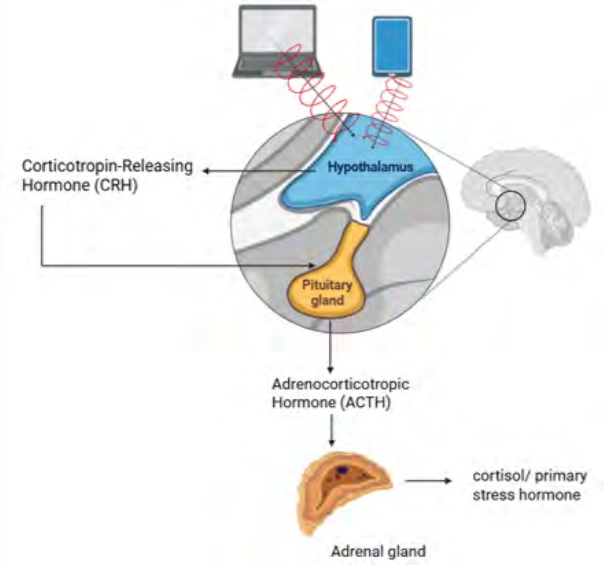

Figure 3: Stimulation of stress hormone production.

the evening to induce sleep and decreases in the morning [33-35]. Mobile and web devices emit short-wavelength blue light (ranging about 450–480 nm) which mimics daylight. Specialized retinal ganglion cells contain melanopsin, a pigment sensitive to blue light. These cells do not help in vision, but send signals directly to the suprachiasmatic nucleus (SCN) in the hypothalamus. The SCN interprets blue light as a signal of daytime. When active, the SCN inhibits the pineal gland via a neural pathway [36,37]. The pineal gland normally converts serotonin into melatonin during the night. Under blue-light stimulation, sympathetic output to the pineal gland decreases, reducing the enzyme N-acetyltransferase (NAT) activity, which is the key for melatonin synthesis. As a result, melatonin levels drop. The brain fails to get the "nighttime" signal. Consequences of prolonged melatonin suppression are delayed sleep phase, insomnia, reduced REM sleep quality, daytime fatigue and cognitive decline, mood disturbances [38]. Figure 4 describes normal sleep cycle and Figure 5 shows influence of blue light/EMR on sleep cycle.

Web addiction also can increase cortisol and dopamine levels, resulting in delayed melatonin onset. Mobile electromagnetic radiation (RF-EMF) may alter pineal function by inducing oxidative stress and disturbing electrochemical signaling, though evidence is still emerging [39].

Mobile phones emit non-ionizing electromagnetic radiation (EMR) in the radiofrequency range (RF-EMF). Studies indicate that chronic exposure to EMR can cause oxidative stress in brain tissues, leading to altered neurotransmitter balance and hormonal dysregulation. EMR exposure affects pineal gland function, thereby reducing melatonin synthesis even in the absence of light [40].

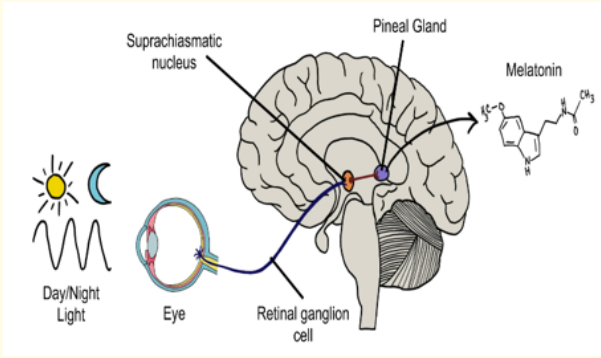

Figure 4: Normal sleep cycle.

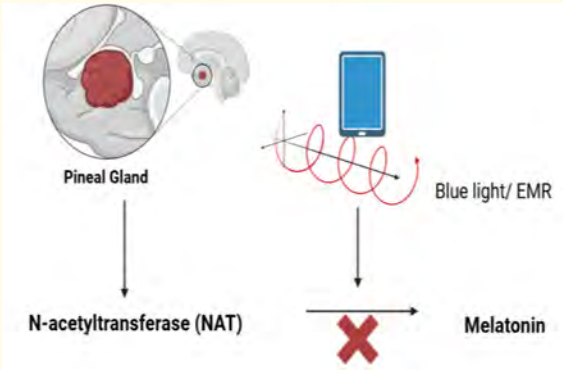

Figure 5: Influence of blue light/EMR on sleep cycle.

Enzymatic regulation and digestive system

The gut-brain axis links emotional stress and digestive control via neurotransmitters like serotonin and acetylcholine [41]. Blue light or web overexposure alters serotonin levels. Serotonin imbalance leads to reduced intestinal peristalsis, altered enzyme secretion and dysbiosis (imbalance in gut microbiota) [42]. On the other hand, melatonin has antioxidant and metabolic regulatory roles. Exposure to blue light suppresses melatonin secretion from the pineal gland, and so reduction of which ultimately causes increased oxidative stress, impaired insulin regulation, altered

digestive enzyme timing like amylase, pepsin and lipase. Mobile radiation generates electromagnetic stress in body tissues, which causes the production of reactive oxygen species (ROS) and lipid peroxidation in intestinal mucosa. ROS interferes with Pancreatic enzyme synthesis (amylase, lipase) and liver detoxification enzymes (cytochrome P450) [43]. Decreased enzymatic efficiency leads to slower digestion and nutrient absorption. Continuous use of social media and web exposure may also trigger dopamine and cortisol release. Chronic cortisol elevation inhibits gastric acid and digestive enzyme secretion and causes gut motility disturbances, results constipation or diarrhea [44].

Discussion

Exposure to android mobile light especially blue light emitted from screens along with continual engagement with digital platforms and electromagnetic radiation, has become an unavoidable part of modern life. Prolonged exposure to blue light can disrupt the body's natural circadian rhythm by suppressing melatonin production. When melatonin levels decline, the entire hormonal system can experience imbalance because sleep plays a critical role in the regulation of sex hormones (such as oestrogen and testosterone), stress hormones (like cortisol), and metabolic hormones (including insulin and ghrelin). Elevated cortisol over time can interfere with reproductive hormone balance, leading to irregular menstrual cycles, reduced libido, and mood fluctuations. In addition, prolonged stress and hormonal imbalance affect enzyme secretion in the gastrointestinal tract. This can slow digestion, reduce nutrient absorption, and lead to symptoms such as bloating, acidity, or constipation. The web also contributes to mental fatigue and stress, which further elevates cortisol. Excessive electromagnetic radiation exposure does not have conclusive evidence for severe hormonal disruption, but current findings indicate it may influence oxidative stress, which indirectly affects hormonal and enzyme pathways. Thus, the combined impact of mobile light, digital overuse, and EMR exposure creates a cycle of sleep disturbance, hormonal dysregulation, and impaired digestive function.

Conclusion

Android mobile light and excessive digital exposure can meaningfully disrupt the body's hormonal balance and digestive functioning. Blue light suppresses melatonin, disturbing sleep cycles that are essential for the healthy regulation of sex hormones, stress hormones, and metabolic hormones. Therefore, minimizing late-night mobile use and maintaining balanced digital habits can significantly reduce the risk of hormonal imbalance and digestive irregularities. More scientific studies are needed for long-term effects. However, current findings strongly support the time demand for unfolding the responsibility of mobile-light exposure that affects overall physiological health.

Bibliography

1. Heroux P., *et al*. "Cell phone radiation exposure limits and engineering solutions". *International Journal of Environmental Research and Public Health* 20.7 (2023): 5398.

2. Nehru V. "Global Wireless Spiderweb: The Invisible Threat Posed by Wireless Radiation". Partridge Publishing; (2016).

3. Aghaei M., *et al*. "A review on the impact of the electromagnetic radiation .EMR) on the human's health". InProceedings National graduate conference (NatGrad2012), Universiti Tenaga Nasional, Putrajaya Campus (2012): 8-10.

4. Kulkarni PP and Mahalle PN. "Electromagnetic Radiations: Exposure and Impact". *CRC Press* (2025).

5. Singh A., *et al*. "Mobile phone radiations as an alarming tool for human health". *Indian Journal of Natural Sciences* 7.5 (2020): 163-166.

6. Mortaza SM., *et al*. "Is it blue light or increased electromagnetic fields which affects the circadian rhythm in people who use smartphones at night". *Iranian Journal of Public Health* 45.3 (2016): 405.

7. Parasuraman S., *et al*. "Health hazards with electromagnetic radiation". *International Journal of Pharmaceutical Investigation* 8.4 (2018).

8. Martirosova VG., *et al*. "Blue light as an occupational health problem". *Ukrainian Journal of Occupational Health* 3.15 (2019): 194-203.

9. Havas M. "Health concerns associated with energy efficient lighting and their electromagnetic emissions". *Health* (2005).

10. Cheng F., *et al*. "Experimental research on the electromagnetic radiation (EMR) characteristics of cracked rock". *Environmental Science and Pollution Research* 25.7 (2018): 6596-608.

11. Kong B., *et al*. "Electromagnetic radiation characteristics and mechanical properties of deformed and fractured sandstone after high temperature treatment". *Engineering Geology* 209 (2016): 82-92.

12. Hipolito V and Coelho JM. "Blue Light of the Digital Era: A Comparative Study of Devices". InPhotonics 11.1 (2024): 93.

13. Randjelovic P., *et al*. "The effect of reducing blue light from smartphone screen on subjective quality of sleep among students". *Chronobiology International* 40.3 (2023): 335-342.

14. Nath A. "Comprehensive study on negative effects of mobile phone/smart phone on human health". *International Journal of Innovative Research in Computer and Communication Engineering* 6.1 (2018): 575-581.

15. Zamanian A and Hardiman CJ. "Electromagnetic radiation and human health: A review of sources and effects". *High Frequency Electronics* 4.3 (2005): 16-26.

16. Sharma AB and Lamba OS. "A review: source and effect of mobile communication radiation on human health". *Advances in Wireless and Mobile Communications* 10.3 (2017): 423-35.

17. Sarwar M and Soomro TR. "Impact of smartphone's on society". *European Journal of Scientific Research* 98.2 (2013): 216-26.

18. Beale R. "Supporting social interaction with smart phones". *IEEE Pervasive Computing* 4.2 (2005): 35-41.

19. Medona RS., *et al*. "An interventional study on effects of mobile screen usage on digital eye strain and insomnia among prospective teachers".

20. Bagaji S and Rao R. "Digital fatigue in the age of screens: eye and postural strain among 18–35-year-old screen users".

21. Stringham JM., *et al*. "Macular carotenoid supplementation improves visual performance, sleep quality, and adverse physical symptoms in those with high screen time exposure". *Foods* 6.7 (2017): 47.

22. Akman M. "The Influence of Virtual Learning on the Rise in Screen Time Usage and Blue Light Exposure Ultimately Expanding Sleep Disturbances amongst Students".

23. Oduwole OO., *et al*. "The roles of luteinizing hormone, follicle-stimulating hormone and testosterone in spermatogenesis and folliculogenesis revisited". *International Journal of Molecular Sciences* 22.23 (2021): 12735.

24. Al-Suhaimi EA., *et al*. "Regulation of male and female reproductive functions". InEmerging concepts in endocrine structure and functions (2022): 287-347.

25. Mailankot M., *et al*. "Radio frequency electromagnetic radiation (RF-EMR) from GSM (0.9/1.8 GHz) mobile phones induces oxidative stress and reduces sperm motility in rats". *Clinics* 64 (2009): 561-565.

26. Chappel SC and Howles C. "Reevaluation of the roles of luteinizing hormone and follicle-stimulating hormone in the ovulatory process". *Human Reproduction* 6.9 (1991): 1206-1212.

27. Raju GA., *et al*. "Luteinizing hormone and follicle stimulating hormone synergy: A review of role in controlled ovarian hyper-stimulation". *Journal of Human Reproductive Sciences* 6.4 (2013): 227-234.

28. Hemayatkhah Jahromi V., *et al*. "Study on the effects of mobile phones waves on the number of ovarian follicles and level of FSH, LH, estrogen and progesterone hormones in adult rats". *Journal of Cell and Tissue* 1.1 (2010): 27-34.

29. Geronikolou SA., *et al*. "Frequent cellular phone use modifies hypothalamic–pituitary–adrenal axis response to a cellular phone call after mental stress in healthy children and adolescents: A pilot study". *Science of the Total Environment* 536 (2015): 182-188.

30. Aguilera G. "Corticotropin releasing hormone, receptor regulation and the stress response". *Trends in Endocrinology and Metabolism* 9.8 (1998): 329-336.

31. Itoi K., *et al*. "Regulatory mechanisms of corticotropin-releasing hormone and vasopressin gene expression in the hypothalamus". *Journal of Neuroendocrinology* 16.4 (2004): 348-355.

32. Yaochen L., *et al*. "Triggered by Design: How Algo rithmic Features of Social Media Disrupt Emotions and Academic Outcomes".

33. Kayabekir M. "Neurophysiology of basic molecules affecting sleep and wakefulness mechanisms, fundamentals of sleep pharmacology". InSleep medicine and the evolution of contemporary sleep pharmacotherapy 2021 Sep 15. IntechOpen (2021).

34. Ono D and Yamanaka A. "Hypothalamic regulation of the sleep/wake cycle". *Neuroscience Research* 118 (2017): 74-81.

35. Pandi-Perumal SR., *et al*. "Role of the melatonin system in the control of sleep: therapeutic implications". *CNS Drugs* 21.12 (2007): 995-1018.

36. Hattar S., *et al*. "Melanopsin-containing retinal ganglion cells: architecture, projections, and intrinsic photosensitivity". *Science* 295.5557 (2002): 1065-1070.

37. Provencio I and Warthen DM. "Melanopsin, the photopigment of intrinsically photosensitive retinal ganglion cells". *Wiley Interdisciplinary Reviews: Membrane Transport and Signaling* 1.2 (2012): 228-237.

38. Jiang N., *et al*. "Effect of monochromatic light on the temporal expression of N-acetyltransferase in chick pineal gland". *Chronobiology International* 37.8 (2020): 1140-1150.

39. Macit HB., *et al*. "A research on social media addiction and dopamine driven feedback". *Journal of Mehmet Akif Ersoy University Economics and Administrative Sciences Faculty* 5.3 (2018): 882-97.

40. Sharma A., *et al*. "Oxidative damage in the liver and brain of the rats exposed to frequency-dependent radiofrequency electromagnetic exposure: biochemical and histopathological evidence". *Free Radical Research* 55.5 (2021): 535-546.

41. Santos J., *et al*. "Stress, microbiota, and the gut–brain axis in mental and digestive health". *Medicina Clínica (English Edition)* 164.6 (2025): 295-304.

42. Gonzalez Delgado S., *et al*. "Interplay between serotonin, immune response, and intestinal dysbiosis in inflammatory bowel disease". *International Journal of Molecular Sciences* 23.24 (2022): 15632.

43. Hanukoglu I. "Antioxidant protective mechanisms against reactive oxygen species (ROS) generated by mitochondrial P450 systems in steroidogenic cells". *Drug Metabolism Reviews* 38.1-2 (2006): 171-196.

44. Konturek PC., *et al*. "Stress and the gut: pathophysiology, clinical consequences, diagnostic approach and treatment options". *Journal of Physiology and Pharmacology* 62.6 (2011): 591-599.