



IN ERA OF COVID-19, ROLE OF CIRCADIAN BIOLOGICAL CLOCK IN MENTAL HEALTH OF PAKISTANI POPULATION

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Abstract

The human immune system is linked to the circadian rhythm, which is controlled by the suprachiasmatic nucleus (SCN) in the central nervous system. The Circadian Biological Clock (CBC) integrates the external environmental changes with internal human physiology. This clock provides temporal accuracy and strong adaptation to the surrounding environment. When CBCs are disrupted or misaligned, as a result of shift work, social jet lag, or other lifestyle factors, adverse mental health consequences arise such as mood disorders and anxiety. Prolong disruption leads to OCDs or schizophrenia. There is compelling evidence that disrupting the circadian biological clock can wreak havoc on one's mental health. This study highlights the impact of CBC on the general mental health of the Pakistani population during COVID19 pandemic. For this purpose, survey research designed with a purposive sampling technique to collect data by using two tools and a sample of (N=379) individuals that selected from Lahore, Pakistan. Results revealed that the CBC explained significant variance with general mental health. The current research focused on the negative consequences of modern living practices and the importance of promoting synchronised lifestyle changes to align body rhythms for optimum mental health.

Keywords: COVID-19, circadian biological clock, general mental health, lifestyle practices

Introduction

During the COVID-19 pandemic when people from all over the world has disrupted life patterns, the researchers of the present era attracted to study the vital effects of the circadian biological clock on organism mental and physical health. The COVID-19 pandemic cause certain issues such as anxiety, stress, health issues, financial issues and employment issue. This unexpected and unpredicted disaster cause sleep disturbance among health care worker and among people. Healthy sleep is highly required to cope with casualties due to COVID-19 pandemic (Charles et al., 2020).

The term "circadian" comes from two Latin words, circa (approximate) and dies (day), which together mean "about one day" (Aknc & Orhan, 2016). It's also known as a biological clock (zbayer et al., 2011), and it causes behavioural, physiological, and chemical changes over the course of a 24-hour biological cycle (Gumz, 2016). The biological clock is divided into two parts: the first is the central clock, which resides in the hypothalamic suprachiasmatic nucleus (SCN). The central clock, which receives light cues, and the peripheral clocks, which are distributed



throughout the body in various tissues. Peripheral clocks have a critical and unique role in each of the body's tissues, controlling the circadian expression of specific genes involved in a variety of physiological tasks (Richards & Gumz, 2012).

Light is a significant stimulation for the SCN (Güldür & Otlu, 2017). Blind persons, on the other hand, have circadian cycles (sleep-wake cycles) that last longer than 24 hours. Other cues, in addition to light, can act as a stimulation for the human biological clock, according to this finding (Allen, 2001). In a review study (Güldür & Otlu, 2017), temperature, hormones, nutrition, nutrient distribution, some nutrients (alone; e.g., glucose, amino acids, ethanol, and retinoic acid), feeding/fasting status, sleep-wake state, and physical activity were identified as effective circadian cycle stimuli in multiple peripheral pathways. The circadian rhythm is primarily regulated by the sleep-wake cycle.

The circadian timing system, commonly known as the circadian clock, is responsible for the sleep-wake cycle, hormone synthesis, cardiovascular health, glucose homeostasis, and body temperature regulation. Energy balance is also one of the most important foundations of metabolic processes, and it has been connected to a number of diseases (i.e., obesity, diabetes, cardiovascular disease). The circadian clock is a crucial regulator of metabolism, and this study investigates the bidirectional effect of circadian rhythm on metabolic processes and energy balance (Serin & Tek, 2019). This metabolic process and energy process directly involved with many mental and physical diseases. So present research highlights the importance of circadian clock to balance this energy.

Since the development of COVID-19, surveys of healthcare workers have found dangerously high rates of insomnia (34–36%), anxiety (45%), and depressive symptoms (50%) among frontline employees who are closely related with COVID-19 patients (Lai et al., 2020; Zhang et al., 2020). According to data from the general population, insomnia, sleep loss, and poor sleep quality are also prevalent concerns, with rates equivalent to those linked with previous major disasters such as earthquakes, floods, or wildfires (Belleville et al. 2019). It's hardly unexpected that people with more severe anxiety and depression symptoms have more sleep interruptions during COVID-19. On the other hand, those with a strong social support system and a sense of belonging report fewer psychiatric symptoms and better sleep quality (Iqbal et al., 2025, 2025; Mayo et al., 2025; Zulfiqar et al., 2025; Umar et al., 2024; Hameed et al., 2022; Xiao et al., 2020).

Any stressful life event, whether personal or induced by natural disasters that jeopardise one's psychological or physical well-being, is likely to cause sleep disorders, especially for those who are more vulnerable (Charles et al., 2020). Aside from stress, the COVID-19 pandemic is fueled by at least two other factors: the effects of confinement and irregular work patterns. Sleep-wake rhythms are regulated by the circadian timing system, which is driven by daylight exposure and several social and environmental timekeepers, as well as homeostatic pressure (duration of awake).

Sleep and circadian rhythms have been studied in temporal isolation, in which participants are isolated from the outside world for several days (they can sleep, eat, and use artificial light as needed, but no contact with the outside world), and it has been discovered that their sleep schedules become desynchronized with the outside world quickly (Revell & Eastman 2005). Many health care personnel and security agents work irregular shifts at various times of the day, increasing the risk of sleep disruptions and sleep loss. When those workers return home to take care of their children and families, these problems might become even worse. Circadian (24-hour) timing systems are found throughout all kingdoms of life and are used to enhance human behavior and



physiology. So, there is a strong need to address the effects of sleep disruption on workers with disturb circadian rhythm.

Changes in our surroundings, like as the addition of artificial illumination, have the potential to disrupt the circadian system, which includes everything from the molecular clocks that regulate cellular activity timing to the synchronization between our daily cycles of behaviour and the solar day. Normally organisms evolved their circadian clocks according to recurring changes in the environment and easily adjusted their behavior and physiology accordingly (Harmer, Panda, and Kay, 2001). Peripheral circadian clocks that are found in most of the organs produce timing signals from the suprachiasmatic nucleus to synchronize physiology with external time (Schibler et al., 2003). The synchronization of circadian clocks with external time regulates the different biological and behavioral functions (Kivelä et al., 2018) and help to regulate organisms' mood and emotions.

The circadian biological clock (CBC) integrates the external environmental changes and internal physiology of an organism. It is responsible to temporal accuracy and strong adaptation to the surrounding environment. In the general population, social jet lag, night shift work, or exposure to artificial lights at night are some main reasons for disrupted CBC that can precipitate or exacerbate the symptoms of physical and mental health Problems (Walker et al., 2020). A relationship between disturbing circadian rhythm via jet lag, exposure to artificial light or night shift work, and mental health problems exist that exacerbate or precipitate effective symptoms in susceptible people (Walker et. al., 2020).

For a long period, researchers try to explore and understand mental health predictors that are important for a healthy life (Tariq et al., 2024; Ali et al., 2023; Sabri et al., 2021). A group of researchers focuses on the biological factors of happiness like balance in circadian rhythm or a healthy immune system and others believe in the environmental factors like good education, high income, and being active during life. Past literature concluded that mental health and life satisfaction integrated numerous factors, not caused by just one or two factors (Gillani et al., 2022). Mental Health is a state of wellbeing in which an individual can cope with daily life stressors, well-adjustment in his/her personal and professional life, and productively contribute to community welfare (Khizer et al., 2024; Sadaf et al., 2024; Javed et al., 2020). Mental health problems are characterized by alteration in mood, sadness, irritability, alteration in appetite, sleep, or sexual desire, and inability to experience pleasure in daily life (Khan et al., 2021; Belmaker & Agam, 2008).

During COVID-19, social isolation contributes to us changing our everyday habits, including as getting up in the morning, eating on time, exercising, and engaging in social and leisure activities. Fix time activities are crucial timekeepers for our sleep-wake cycles, which are disrupted by the pandemic. The shift in the above-mentioned timekeepers, together with decreased daylight exposure, resulted to desynchronization with the day and night cycles, disrupting sleep and circadian rhythms. Desynchronization of the CBC is important for mental and physical health (Morin et al., 2020). The current study is a legitimate attempt to keep the public informed about the relevance of the sleep-wake cycle in dealing with the epidemic and minimizing the negative impacts on mental health issues. The current research focused on the negative consequences of modern living practices and the importance of promoting synchronized lifestyle changes to align body rhythms for optimum mental health.



Research Problem:

What is the role of Circadian Biological Clock in Mental Health of Pakistani Population during COVID-19?

Hypothesis of the Study:

- Circadian biological clock (CBC) would be a significant predictor of General Mental Health of the Pakistani population in the era of Covid-19.
- There would be a significant difference between undergraduate and graduate participants in reference to their circadian biological clock and general mental health.

Materials and Methods

In the current study, a survey research design with a purposive sampling technique was used to collect data from the participants. A sample was taken from several parts of Lahore, Pakistan. Sample size was selected according to the guidelines of Cohen’s (1988) (that is 5 or 7 cases per predictor variable (Maqbool et al., 2022). A total of 379 males (31%) and females (69%) between the ages of 18 and 53 years old took part in the study. About participants’ education, 46% were under graduated, 39% were graduated and 15% hold the degree of post-graduation. Due to covid-19 pandemic sample was approached through online survey technique. A google form was generated that consisted of a consent form and study variables.

A 15-item scale to measure the circadian biological clock (Byrne et al., 2017) was used including three different factors i.e., good sleep, morningness and depressed mood. A 12-item scale for general mental health (Goldberg, 1972) including positive and negative items was used to investigate the study variables. For statistical analysis, Statistical Package for Social Sciences (SPSS) was used. All ethical standards outlined by APA were also adhered in the present study.

Results

Table 1: Psychometric Properties for Scales

Scales	M	SD	Range	Cronbach's Alpha
Circadian Biological Clock	3.99	.59	2.00 – 5.67	.63
General Mental Health	1.57	.41	.17 – 2.75	.66

Note. M= Mean, SD= Standard Deviation

Table 1 shows psychometric properties for the scales used in the current study. The Cronbach's alpha value for circadian biological scale was .63 (< .70) which indicated low internal consistency. The Cronbach's alpha value for general mental health was .66 (< .70) which also indicated low internal consistency.

Table 2: Regression Coefficient for Circadian Biological Clock on General Mental Health.

Variables	General Mental Health			
	B	β	p	SE
Constant	.90			.14
Circadian biological clock	.17	.24	.001***	.04
R ²	.06			

Note. N = 379, ***p < .001

Table show the impact of circadian biological clock on General Mental Health. The R² value .06 revealed that the predictor variable explained 6% variance in outcome variable with F



(1, 377) = 22.74, $p < .001$. The finding revealed that Circadian Rhythm positively predicted General Mental Health ($\beta .24, p < .001$).

Table 3: Mean Comparison of Under Graduate and Graduate Participants on Circadian Biological Clock and General Mental Health.

Variable	Undergraduate		Graduate		t (198)	p	Cohen's d
	M	SD	M	SD			
CBC	3.96	.59	4.01	.59	0.92	.35	.19
GMH	1.54	.42	1.59	.41	-.97	.33	.22

Note. N = 379; CBC= Circadian biological clock, GMH= General mental health

The table compared undergraduate and graduate participants on circadian biological clock and general mental health. Results showed no significant differences between the two groups on either variable. Graduates scored slightly higher on both circadian biological clock and general mental health, but the effect sizes (Cohen's $d = 0.19$ and 0.22) indicated less than a small effect.

Discussion

Circadian biological clocks play a critical role in coping (mentally and physically) with major life events such as the covid-19 pandemic. Pakistan is one of the developing countries, where people already struggled to attain their basic needs. Quarantine during covid-19 (from 2020 to 2021) was a period of storm and stress for the general population. At this time, people were not only struggling with unexpected health problems but also with financial and educational crises. To overcome these situations, people preferred to work in night shift, online education, or jobs on social media just to meet their financial expenses. Alteration in daily routines such as late-night work, eating at an inappropriate time, delay in the exercise, and less exposure to the natural environment impede the circadian biological clock during this pandemic. So, we can conclude that Covid-19 confinement contributed to desynchronization with CBC that plays a fundamental role in mental and physical health problems.

Present study hypothesis that circadian biological clock (CBC) would be a significant predictor of General Mental Health of the Pakistani population in the era of Covid-19. Findings revealed that Circadian Rhythm positively predicted General Mental Health ($\beta .24, P < .001$). These findings are consistent with previous researches (Kiada & Niki, 2013). Disturbance in circadian biological clock leads to mental health issues. The reason for this could be that the covid-19 epidemic has arisen as a terrible threat to the global economy, social system, and healthcare system. There is no idea when it will be ended but with the help of natural lifestyle practices, we can overcome the harmful effects of this situation on our mental and physical health. People should emphasize altering their daily routines such as arising in the morning, eating at the proper time, exercising, engaging in social and leisure time activities. Fix time activities are important timekeepers for our sleep-wake cycles that impede during this pandemic. Covid-19 confinement contributed to desynchronization with the day and night cycles, to follow the above-mentioned timekeepers, combines with increase daylight exposure can be effective for CBC and good mental health (Estman et al., 2015).

Another hypothesis states that there would be a significant difference in undergraduate and graduate participants in reference to the level of circadian biological clock and general mental health. Findings revealed non-significant difference on circadian biological clock and general mental health. The reason of non-significant results could be the lockdown. Due to lockdown all participants have ample of time to relax and improve their sleep quality. However, on the bases of



mean score it was seen that CBC and general mental health level is high in graduates. It could be said that graduates do not have much educational burden as they might develop schedules to manage their activities as compare to undergraduates who are in learning phase. The difficulty of moving from adolescents to adulthood, as well as how a lack of prior experience and coping abilities may increase college students' vulnerability to sleep disturbance, which disrupts the circadian biological clock and leads to mental health problems (Towbes & Cohen, 2011).

Conclusion

The study concludes that circadian rhythm significantly predicts general mental health, with better regulation linked to improved wellbeing. No meaningful differences were found between undergraduates and graduates, suggesting educational level does not affect this relationship.

Future Suggestions

Future research should explore both mental and physical aspects of the circadian biological clock (CBC), with attention to cultural influences and daily life practices. The link between CBC disruption and psychopathology remains unclear, warranting experimental studies to determine causality. Public health initiatives should also raise awareness about CBC and promote healthy lifestyle practices to prevent long-term adverse effects.

Conflict of Interest

No potential conflict of interest was reported by the authors.

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