

Frequency of Cardiac Events Associated with Circadian Rhythm Disruption: A focus on Cardiac Arrest

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Abstract

Circadian rhythm indicates any physiological process that displays a day-night cycle. Biological measures of the circulatory system, such as heart rate (HR), blood pressure (BP), vascular resistance, and cardiac electrical cycle duration, display notable daily variation, (Zhang et al., 2014). Cardiovascular diseases (CVDs) are the leading cause of mortality worldwide. Their primary source is the development of atherosclerotic plaque (arterial fatty deposits), which comprises the accumulation of fats and inflaming leukocytes within the coronary arteries. Besides high cholesterol, diabetes mellitus, excess body weight, hypertension and nicotine consumption, the disturbance in circadian cycle has recently been launched as a contributing risk factor liable for the formation and evolution of cardiovascular diseases, (Tian et al., 2024). Heart disease is a significant reason for fatalities globally, while adopting biological rhythm research in cardiac science (and evidence-supported healthcare overall) supplies an innovative applied research strategy to benefit patients clinically, (Reitz & Martino., 2015). In 2017, cardiovascular diseases resulted in about 17.8 million

deaths worldwide, corresponding to 330 million years of diminished life expectancy and an additional 35.6 million years lived with impairment.

1.1 Background

Circadian rhythm indicates any physiological process that displays a day-night cycle. Biological measures of the circulatory system, such as heart rate (HR), blood pressure (BP), vascular resistance, and cardiac electrical cycle duration, display notable daily variation, (Zhang et al., 2014). Cardiovascular diseases (CVDs) are the leading cause of mortality worldwide. Their primary source is the development of atherosclerotic plaque (arterial fatty deposits), which comprises the accumulation of fats and inflaming leukocytes within the coronary arteries. Besides high cholesterol, diabetes mellitus, excess body weight, hypertension and nicotine consumption, the disturbance in circadian cycle has recently been launched as a contributing risk factor liable for the formation and evolution of cardiovascular diseases, (Tian et al., 2024). Heart disease is a significant reason for fatalities globally, while adopting biological rhythm research in cardiac science (and evidence-supported healthcare overall) supplies an innovative applied research strategy to benefit patients clinically, (Reitz & Martino., 2015). In 2017, cardiovascular diseases resulted in about 17.8 million deaths worldwide, corresponding to 330 million years of diminished life expectancy and an additional 35.6 million years lived with impairment. Approximately 80% of worldwide cardiovascular diseases deaths happen in low- and middle-income countries (LMIC) where CVD and risk factors impact are on the rise as a result of a continuing shift in disease pattern, (Mensah et al., 2019).

The Framingham Heart Study reports a 49% lifetime risk of coronary heart diseases (CHD) for men and 32% for women. Most CVDs are the result of an atherosclerotic pathologic activity in the blood vessels present all over the body, and is mostly preventable through mitigation of risk factors. Risk factors are medical conditions, body states, biological plethora markers, or additional recognizable factors that are linked with an increased occurrence of cardiovascular disease in populations possessing these risk factors, (Eaton., 2005). Disturbance in circadian variation is the changeable risk factor of CVDs. Disruptions in proper biological function may elevate the risk for cardiovascular diseases (CVDs).

Sleep is a crucial physiological condition of health, affecting approximately all major organs and organ systems, biological processes, and functions and systems throughout the organism. Sleep is also a vital changeable lifestyle and is evaluated as one of the three cornerstones of a healthy life, in addition to diet and exercise, to encourage ideal health and optimal functioning of a person. As sleep is a multifaceted phenomenon exhibiting a range of features like duration of the sleep, caliber, scheduling and fluctuations which have notable effects on health and wellbeing, (Matricciani et al., 2018).

The correlation among short-term and long-term sleep patterns, along with sleeplessness, with CVD risk is widely acknowledged. Recent studies have demonstrated in what way several rest-related elements, including circadian consistency (such as consistency of sleep timing), multifaceted sleep health (sleep caliber, scheduling, regularity and durations) and biological rhythm components such as sleep-wake cycle and social time lag, linked to elevated cardiovascular risk. Rest-oriented preventions and protocols (e.g., cognitive behavioral therapy CBT (behavioral sleep medicine) for insomnia, improving sleep depth and increasing sleep duration) might be beneficial to decrease the formation and advancement of CVD risk and disease burden. We analyze the association between sleep and circadian factors with cardiovascular disease (CVD) risk, (Belloir et al., 2022).

Circadian rhythm disruption, known as Chrono disruption, leads to circadian misalignment in the body, or disruption of the time-based balance that commonly occurs between the internal circadian mechanism and the timetable of actions, like sleep-wake and eating-fasting cycles. Circadian disruption can lead to a variety of psychological and physical disorders, including CVD risk, (Baron & Reid., 2014). Measured and subjective sleep disruption can cause CVDs. An irregular sleep time,

which leads to quantitative sleep issues including long-term sleeplessness (insomnia) and Sleep Disorder Breathing (SDB) which can influence the occurrence of cardiovascular disorders. As in contrast to the general public, participants having CVDs usually sleep less and often have sleeping issues including long-term sleeplessness. Thus, sleep plays an important role in progression and development of cardiovascular diseases, (Matsumoto & Kasai., 2017).

The circadian rhythm, an internal biological clock which regulates the various physiological processes including hormones secretions, sleep wake cycle and cardiovascular health. Due to our circadian clock, humans and other animals are able to anticipate, respond, and adapt to environmental changes such as daily light and dark cycles. Any disruptions in Circadian Rhythm whether due to lifestyle choices, shift work, medical conditions or environmental stressors can lead to adverse health outcomes.

Increasing evidence suggests that circadian rhythm disruption is associated with an elevated risk of cardiovascular diseases, including cardiac arrest. There is a bidirectional relationship where circadian rhythm disruptions influence pre-existing cardiac conditions or directly contribute to acute cardiac events. This connection is particularly relevant in regions like Pakistan and Azad Kashmir where cardiovascular diseases are very high, yet awareness about circadian health remains limited.

1.2 Statement of the purpose

The circadian clock functions as a gradually developed time regulator which manages functional methods throughout 24 hours. Within the cardiovascular system, several parameters such as blood pressure, heart rhythm, and metabolism, demonstrate diurnal modifications. Those characteristics are partially inspired by the sleep-wake cycle. Long term disturbance of daily regularity due to shift work or abnormal social timetable has been linked with a high risk of hypertension, arrhythmias, and myocardial infarction, (Lecacheur et al., 2024). To support adaptability to immediate, enhanced exercise after Wake up, many cardiovascular boundaries demonstrate a circadian format, (Allada & Bass., 2021). Significantly, negative cardiovascular happenings also arise more frequently at assured times of day, (Muller et al., 1995). These incidents include MI, abrupt heart death, and cerebral infarction which all peak around the sleep-to-wake shift in the early morning, (Thosar et al., 2018). Indeed, it is gradually identified that the whole circadian beat plays a vital part in maintaining cardiovascular wellness, overall health, and recovery from cardiac illness. Alternatively disturbing beats are linked with an increased danger of heart disease, harmful heart events, and more severe outcomes, (Khaper et al., 2018). Recent studies show that the likelihood of cardiac disorders is greater among shift employees compared to daytime workers. The danger of development of heart diseases is 17% higher in those who have irregular sleep models than normal ones. The danger of heart disease is 26% higher in people having an upset sleep-wake pattern, (Torquati et al., 2018).

Cardiac arrest accounts for a significant proportion of sudden deaths globally but underlying triggers, particularly modifiable risk factors like circadian rhythm disruptions remain unexplored. Despite the growing body of international research on this subject there is limited data specific to the local population of Pakistan and Azad Kashmir. This gap in knowledge hinders effective prevention and intervention strategies related to the regional context. According to a global burden of disease survey a total of 1.4 million CVD deaths (95% UI: 1.3 -- 1.5) occurred in 2015 in the eastern Mediterranean region, with the highest number of deaths in Pakistan (465,116) and the lowest number of deaths in Qatar (723), (Mokdad et al., 2018). In January 1 and December 31, 2014, 12 hospitals in Beijing participated in this prospective research reporting an in-hospital cardiac arrest incidence of 1.3 per 1,000 hospital admissions. The rate of survival until hospital discharge was 9.1% while favorable neurological recovery was observed in 6.1% of cases, (Zheng et al., 2023). Fourier analytical assessment revealed a significant circadian fluctuation in cardiac events ($p < 0.001$), with

a nighttime decline at 2:00–3:00, a morning surge at 9:00–10:00, and an afternoon rise at 16:00–17:00. Circadian rhythmicity was evident in all subgroups except females and individuals below 55 years of age, (Xia et al., 2021). The primary leading reason for death in Iran was “heart attack” (over 99%) and chiefly the site of death occurred before hospitalization (50%), which happened in 82% of incidents amid rest or daily activity, and largely within the initial hour (60%) and the most common duration for death was between 6 am and noon (39.6%). The predominant coronary involvement included LAD+ RCA arteries (77%), (Sara et al., 2016). In Pakistan, 1068 external-hospital cardiac arrest (OHCA) participants were enrolled with an average age of 55 years, 61.1% (n = 653) male. Overall existence to release amounted to 0.75% (n = 8). Of these 8 patients, 7 patients survived to 1-year and 2 to 5-years, (Khan et al., 2024) . Over a span of 3 months, a total of 187 participants were recorded with an average age of 35.1 years in Karachi, Pakistan. About 95% were men, and 68.4% had a perforating injury. One hundred eighty-one individuals (96.7%) were declared deceased upon arrival at the emergency department, and of the remaining 6 individuals, 4 were administered CPR in the emergency units. Overall survival at the end of ED stay was 0%, (Maani et al., 2018). Studies show that CVDs are more common among women as compared to men in Pakistan. Studies show that CVDs are more common among women as compared to men in Pakistan. Findings show that 17.5% of the population of Punjab, Pakistan is determined with vascular diseases which is due to lack of exercise and family history of disease, (Zubair et al., 2018). A total of 220 participants fulfilled the general criteria and experienced SCA. The average age of the examined group was 65±9 years. ROSC was present in 47% of patients, among which 58 patients preserved to discharge (STD) in Hazara division, Pakistan, (Gul et al., 2024). In Azad Kashmir there is a highest death rate related to vascular diseases reported to Bureau of Planning and Development Department AJK by the department of health, (PND., 2022). Single people aged 60 or above have more chances of heart diseases compared to other age groups. Studies finished at that age, high blood pressure, diabetes and family history guiding to 0.97 chances of being a CVD patient in Muzaffarabad, Azad Jammu and Kashmir, (Kanwal et al., 2019).

In our area, there is very limited data/studies on cardiovascular diseases (CVDs) linked with interruption of daily change. Circadian patterns play an essential function in maintaining multiple bodily or biological activities, comprising cardiovascular function. Disruptions in these variations, triggered by elements such as night-shift employment, irregular sleep-wake rhythm, and lifestyle alteration have been linked with a raised risk of vascular diseases. However, due to the lack of regional studies, the degree of this linkage remains unclear. Understanding this organization is important for growing targeted treatments and caution to reduce the ratio or rate of CVDs in our society.

1.3 Mechanism

The relationship among disturbance to the body's inner pattern and cardiac arrest is complex, including a range of physiological and molecular processes, (Bagai et al., 2021; Tran et al., 2021). The human body's internal clock, governed by the suprachiasmatic nucleus and peripheral oscillators in parts such as the heart, coordinate multiple physiological activities, comprising cardiovascular function, (Zhang et al., 2021). Disturbance to these natural patterns can cause adverse impact on adverse cardiovascular results, specifically sudden cardiac arrest (SCA), (Zhang et al., 2021). Circadian biological clocks in heart muscle cells control the manifestation of essential genes in charge for maintaining standard cardiac electrophysiology and metabolism of the body (Schroder et al., 2021). For example, genes such as *Scn5a*, which encodes the sodium channel, and *Kcnh2*, which encodes a potassium channel of the cardiac system, show daily changes that impact the cardiac action potential(Schroder et al., 2021).

Disturbance to these gene rhythmic expressions results in electrical volatility, thereby raising the chance of arrhythmias that can trigger cardiac arrest,(Schroder et al.,

2021).

Current research has clarified the vital role of internal cardiomyocyte circadian clocks in

Preserving normal cardiac electrophysiology (Delisle et al., 2024; Schroder et al., 2023). The expression of key cardiac ion pathway genes follows a daily rhythms controlled by the

molecular clock machinery inside heart cells (Delisle et al., 2024; Schroder et al., 2023). These rhythmic changes are essential for balanced heart roles and proper rhythm regulation throughout the 24- hour duration, (Delisle et al., 2024; Schroder et al., 2023). The manifestation of key cardiac ion pathway genes follows a daily pattern controlled by the molecular

clock machinery within heart cells, (Delisle et al., 2024; Schroder et al., 2023). These rhythmic changes are essential for steady heart roles and proper rhythm regulation throughout the 24-hour cycle, (Delisle et al., 2024; Schroder et al., 2023). When this inherent clock is disrupted, it leads to imbalance of ion pathway display, leading to elevated ventricular sensitivity and an increased sensitivity to serious arrhythmias, (Delisle et al., 2024; Schroder et al., 2023).

The chronological proceed of sudden cardiac arrest proceed a proven daily rhythm,

with main peaks happening in the early hours and late afternoon, (Bagai et al., 2021; Tran et al.,

2021). These peaks correspond with physiological changes , involving the morning spikes in blood pressure and elevated stress related actions, which can activate arrhythmias and cardiac events, (Bagai et al., 2021; Tran et al., 2021). Significantly, the lowest survival rates are regularly seen for cardiac arrest events happening among midnight and 6 AM, a period documented by decreased involuntary reactivity and slowed emergency response, (Bagai et al., 2021; Tran et al., 2021).

The growth of arrhythmias significantly elevated the likelihood of unexpected heart arrest,

Highlighting the vital function of the body's inner rhythm in maintaining cardiac balance.

Inquiry have disclosed that disruption with the natural biological pattern, such as those

Lead by rotating work procedure or extended light-dark phase shifts, lead to irregular

sinoatrial and atrioventricular node operation. These abnormalities result in a disturbance of normal transmission timing, elevating vulnerability to serious ventricular arrhythmias, (Durgan & Young, 2010).

Moreover, disturbance to the circadian rhythm lead instabilities in autonomic nervous

system regulation. Usually, parasympathetic tone dominate throughout the night, providing a

defensive effect to prevent arrhythmias. In contrast, disturbance to the internal biological clock heightened midnight stress related actions, blood pressure, increasing heart rate, and catecholamine levels, all of which can trigger arrhythmogenesis (Haus & Smolensky, 2013).

The neuroendocrine process likewise perform a crucial function in maintaining cardiac

balance. Cortisol, a hormone that precedes a natural daily pattern, generally reaches its maximum levels in the early hours and reduces at night. Disturbance to this rhythm can lead to maximum evening cortisol levels, harming cardiovascular homeostasis, (Wright et al., 2015).

Moreover, melatonin, a hormone that supports sleep and has cardioprotective feature, is

Inhibited by contact to light at night, eliminating a key modulator of midnight cardiovascular

Balance, (Zhao et al., 2023).

On a cellular level, disturbance to the inner clock can reduce self digestion and cellular repair function in cardiomyocytes. This can lead to the collection of harmed proteins and organelles, encouraging myocardial abnormalities and elevating the threat of electrical disturbances

that can activate cardiac arrest, (Morris et al., 2016).

Chronic disturbance to the inner clock can also aggravate inflammatory signaling, leading to increased focus of C-reactive protein, interleukin-6, and tumor necrosis factor-alpha. This pro-inflammatory response surrounding supports architectural rebuilding, fibrosis, and hypertrophy of the myocardium, which are proven threat element for unexpected cardiac arrest,

(Reiter et al., 2014). Moreover, disturbance to the inner clock can disturb cardiomyocyte

Cellular recycling, inhibit the effective elimination of harmed organelles and proteins, and reduce

cellular adaptability to ischemic injury and electrophysiologic stress, (Rabinovich Nikitin et al., 2021; Young et al., 2023).

Concurrently, chronic disturbance of circadian cycles increased systemic swelling, increasing C-reactive protein, interleukin-6, and tumor necrosis factor-alpha, and reducing postischemic myocardial healing. This encourages arrhythmogenic rebuilding noticeable by fibrosis and hypertrophy, structural modifications that have been regularly seen in animal models.

Exposed to light/dark incongruity or clock gene removal, (Che et al., 2024) and (Crnko, S., Du

Pré et al., 2024). Epidemiological inquiry confirm these analytic results, showing that the

frequency of cardiac arrest peaks in the early hours and late afternoon, corresponding with

physiological changes controlled by the body's inner clock, (Rogers et al., 2018). Significantly,

the minimum existence rates are seen for events happening between nocturnal and 6 AM, indicating a temporal susceptibility to cardiac arrest likely effect by circadian biology, (Rogers et al., 2018).

Experimental framework in animals revealed to continuous light or disturbed light-dark cycles

have illustrated raised deaths, myocardial fibrosis, and electrical rebuilding, highlighting the significance of sustaining circadian intactness for cardiovascular health, (Martino et al., 2007).

The body's internal clock regulates vascular tone through fluctuations in endothelial nitric

oxide and endothelin-1, with nitric oxide accessibility typically minimum in the early morning, coordinating with peak times for thrombotic and arrhythmic events, (Nuszkiewicz et al., 2025). Diurnal changes in endothelial responsiveness also communicate with chronotype, with later chronotypes showing large evening vulnerability in flow-mediated enlargement, (Facer-Childs et al., 2019).

Seasonal changes in endothelial operation and arterial stiffness are affected by ambient states, with modern syntheses exhibiting winter-connected reduction in vascular operation and summer-associated advancement, (Gordon et al., 2024). These vascular rhythms range with seasonal blood pressure active, with large community studies proving maximum clinic and home blood pressure in colder months, (Nilles et al., 2023; Mancia et al., 2024).

Additionally, winter home blood pressure changeability is a more effective

indicator of events cardiovascular illness than readings taken in other seasons, strengthening an analytical

Routes from involuntary and endothelial changes to event threat, (Narita et al., 2022). Temperature radical autonomously elevates risk, with both cold and heat raising short term cardiovascular presentations via sympathetic stimulation, endothelial stress, and hemorheological fluctuations, (Ni et al., 2025; Singh et al., 2024).

Short-term surrounding temperature rises also elevates heart rate and decrease oxygen

fullness, with more effective linkages noted in women, (Qu et al., 2025). Blood "fluidity"

changes with season and weather, affecting strain stress and thrombosis, with cold spells intensely elevating plasma stickiness and raising thrombotic inclination, (Schneider et al., 2025; Klompmaker et al., 2025).

Cold encounters further increase sympathetic nerve functionality and peripheral Narrowing of blood vessels, intensifying morning and winter spikes in resistance and platelet responsiveness, (Yoshimoto et al., 2025). These analytical and environmental layers help clarify seasonal patterns of cardiac arrest, with modern series and databases documenting more cardiac arrests in winter, (Ashraf et al., 2023; Ito et al., 2024; Licker et al., 2025). At the end, cerebrovascular study emphasizes the circadian modulations of cerebral blood flow as a simultaneous routes for morning susceptibility, consistent with coordinated cardiocerebral threat windows when narrowing of blood vessels is preferred, thickness is higher, and involuntary tone is pro-arrhythmic, (Webb et al., 2024).

1.4 Significance of the study

This research is primarily significant within the framework of Azad Jammu and Kashmir (AJK), where lifestyle habits, especially within the younger population, caused wide disruption in circadian cycle. A significantly high number of young individuals in AJK have disrupted sleep patterns, they stay awake throughout the night time and sleep during the day time, commonly because of social habits, study pressures, screen time, and limited knowledge about the effects of such practices. This continuous disturbance in the sleep-wake cycle is silently impacting their cardiovascular health negatively, yet the community stays mostly unaware of its significant long-term consequences. The importance of this study is in its ability to fill the knowledge gap in public health and cardiovascular studies in AJK. While cardiovascular diseases (CVDs) are

Globally identified as the leading contributors to illness and death, cardiovascular diseases are also a leading cause of death in AJK, but there are no such region-specific studies that analyze unconventional but modifiable or adjustable risk factors for cardiovascular diseases, including disruption in circadian rhythm. By scientifically demonstrating the association between this specific risk factor of circadian irregularity and the occurrence of cardiac arrest in this region, the study will provide evidence-based insights that can be used to design targeted interventions to prevent cardiovascular disease.

1.5 Aim of study

The aim of the study is to gain valuable insights that can help develop effective strategies. The results from this study contributes to the achievement of Sustainable Development Goal 3 (Good Health and Wellbeing) by providing insights into the relationship between circadian rhythm disruptions and cardiac arrest. By figuring out the potential mechanisms behind this association and investigating the impact of lifestyle factors on the risk of sudden cardiac arrest (SCA), this study aims to contribute for evidence-based strategies to minimize cardiovascular mortality and enhance health outcomes in the population of the region Azad Jammu and Kashmir. The results from this study are predicted to hold significant relevance for developing public health policy and practice, encouraging the need of considering circadian rhythm disruption as a

primary contributing risk factor for cardiac arrest.

By highlighting the relationship between circadian health and cardiac events, this study has the potential to contribute to the broader goal of reducing the burden of CVDs in the region, in alignment with SDG goal 3 (Good health and wellbeing).

1.6 Objectives

The following objectives have been elaborated:

- To analyze the frequency of cardiac arrest associated with circadian rhythm disruption in Cardiac Surgery Hospital, Muzaffarabad.

1.7 Research question

What is the frequency of cardiac arrest associated with circadian rhythm disruption in Cardiac Surgery Hospital, Muzaffarabad?

2. ABSTRACT

Cardiovascular diseases (CVDs) remain a major cause of death worldwide, with cardiac arrest representing one of the most severe and life-threatening outcomes. Recent research highlights the important role of circadian rhythm disruption in regulating cardiovascular physiology and influencing the timing of adverse cardiac events. This study aimed to estimate the frequency and temporal distribution of cardiac events, particularly cardiac arrest, in relation to disturbances in circadian rhythm.

A hospital-based cross-sectional study was conducted among patients presenting with cardiovascular emergencies. Data were collected from medical records, patient histories, and structured questionnaires assessing sleep patterns, work schedules, and other lifestyle factors affecting circadian rhythm. Statistical analyses were performed to determine the association between disrupted sleep-wake cycles and the incidence of cardiovascular diseases. The results demonstrated an increased frequency of cardiac arrest and other cardiovascular events during specific time periods, particularly in the early morning hours, suggesting a strong temporal pattern consistent with circadian regulation. Furthermore, shift work, sleep deprivation, and irregular sleep patterns were identified as significant contributing factors.

In conclusion, the findings emphasize the critical role of the circadian system in cardiovascular health. Recognition of circadian rhythm disruption as a modifiable risk factor may support the development of preventive strategies and guide clinical interventions aimed at reducing the occurrence of cardiac arrest and other cardiovascular complications. Future research should further explore underlying mechanisms and population-specific factors to strengthen the application of circadian-based approaches in cardiovascular medicine.

3. LITERATURE REVIEW

A typical circadian rhythm is essential to sustain a normal heart rhythm disruption can influence the growth of circadian arrhythmias, (Vicent & Martínez-Sellés, 2021). Circadian rhythms play a vital role in cardiovascular purpose and the appearance of cardiac events. Research shows a bimodal allocation of unexpected cardiac arrest, with high in the morning and afternoon due to age, sex and location, (Tran et al., 2021). Ventricular arrhythmias and unexpected death are more common in the morning, while atrial fibrillation and heart blocks happen more efficiently at night (Vicent & Martinez-selles, 2021). Circadian disruption is an essential risk factor for cardiovascular diseases, which includes myocardial infarction, (Tran et al., 2021). Further a cardiovascular variable, which includes heart rate, heart rate variability (HRV) Electrocardiogram (ECG) waveforms, endothelial cell function, and blood pressure, shows strong circadian rhythms. Many experimental and clinical studies have shown that disruption in circadian rhythm can definitely lead to maladaptive cardiac function (Lin, J et al., 2023). Awareness of 24-hours cycle in the risk of cardiac arrhythmias and cardiovascular diseases sickness and fatality plus circadian rhythm-needs of fundamental pathophysiologic process propose the need for preventive and therapeutic intervention is not the same thought-out the day and night and need to customize consequently to enhance result (portaluppi et al.,2012).

The spring transformation to Daylight Saving time (DST) leads to a 27.2% rise in acute myocardial infarction (AMI) enrollment in Indiana, sustained about two weeks. This enhancement is not offset during the day light saving periods and repeats year by year, suggesting no changes. No resembling effects were found in autumn transformation. The discovery shows short term hazards of DST without clear health advantages, contributing to the policy debate on permanent DST, (Tanaka et al., 2024).

All species arrange actions to ideally pair daily modifications in the environment, leading to obvious activity/rest cycles that track the light/dark cycle. Internally, roughly 24-hour circadian variation in the brain, involuntary nervous system, heart, and blood vessels arrange the cardiovascular system for ideal function during these expected behavioral cycles. Cardiovascular circadian variations, however, may be a dual-purpose sword. The normal enhanced reactions in the morning may help the transformation from sleep to activity, but such overstated responses are hazardous in individuals vulnerable to adverse cardiovascular events. In fact, the incident of stroke, myocardial infarction, and sudden cardiac death all have daily variations, appearing most repeatedly in the morning. Additionally, long term disturbance of the circadian rhythm, as with night-shift work, leads to increased risk of cardiovascular diseases, (Thosar et al.,2018).

Sudden cardiac arrest (SCA) is a complicated public health problem caused by the termination of cardiac electrical and mechanical activity. Although improvements in pedestrian lifesaving technologies like defibrillators, the SCA mortality rates are constantly high, and survivors are at risk of suffering ischemic injury to various organs. Demonstrating the contributing factors for sudden cardiac arrest is important for improving morbidity and mortality. One factor capable of affecting sudden cardiac arrest's incidence and survival is the time of day at which SCA occurs (Tran et al.,2021).

Almost all cardiovascular factors that have been evaluated during research at different times of the day and night in humans have been found to have a day/night rhythm, including heart rate and blood pressure (BP), (Weber et al., 1984,). Blood coagulation markers, (Angleton et al., 1989). Furthermore, epidemiological data exposes a high morning increase in adverse cardiovascular events, including stroke, (Elliott, 1998), heart attack, (Muller et al., 1985), serious abnormal heart rhythms, (Twidale et al., 1989) and sudden death from cardiac arrest, (Willich et al., 1992). We assess how extended disturbance of the internal biological rhythm, whether by night shift work, airline jet lag (time zone fatigue), or social jetlag (circadian misalignment) are hazardous to cardiovascular health, (Rutters et al., 2014). Circadian variation also slows healing from cardiovascular events. For intense, healing from practically caused myocardial infarction is impaired in mice by quickly shifting light/dark cycle, recommending that sleep and circadian rhythm disruption that occurs in intensive care units (ICU) may compromise recovery from myocardial infarction, (Alibhai et al., 2014). Estimated that around 70% of the population has visible social jetlag (i.e., their biological and social clocks differ by more than 1 hour.), (Roenneberg et al., 2012). Moreover, just 1 hour of changes in behavior, such as when daylight savings time begins in spring, can lead to a short-term increase in heart attacks, (Jiddou et al., 2013). We report the organization of the circadian system and discuss the function it plays in heart, vasculature, and blood, and then outline those circadian variation or changes in resting cardiovascular physiology and especially the cardiovascular sensitivities to triggers; and suggest how such circadian cycle may connect to the founded days/nights patterns of adverse cardiovascular events, (Muller et al., 1985).

Although there is a rising body of global studies on linkages between disturbance of circadian rhythm and cardiac events, especially cardiac arrest, there remains a significant limitation in regional studies on this issue. Various international studies have analyzed the biological processes associating circadian disorder (majorly resulting from shift work, sleep disturbance, or lifestyle factor) to increased risk of cardiovascular diseases. However, a review of the available literature exposes a significant data gap

and evidence-based studies originating from this region. The empty space presents significant restrictions, as Geographical difference in lifestyle, healthcare system, and heritable traits ecological exposures and task sequence may dominate the expression and effect of circadian disruption alternatively evaluated to other citizens. Free from localized studies, it is very difficult to evaluate the Global finding to our precise background to implement focused public health action and clinical plans. Consequently, the shortage of localized data emphasizes immediate requirements for detailed studies that examine the Alliance within our local populations. Focusing on research gap is important not only for progressing scientific knowledge but also for notifying local healthcare guidelines and preventive measures customized to an exclusive trait for our community.

4. METHODOLOGY

4.1. Study Design

This study was designed as a quantitative cross-sectional study to assess the frequency of cardiac events associated with circadian rhythm disruption, with a specific focus on cardiac arrest.

4.2. Study Setting

The study was conducted at the Cardiac Surgery Hospital, Muzaffarabad (AJK). Data were collected from the different departments, Emergency Room (ER), Coronary Care Unit (CCU), and inpatient wards of the hospital.

4.3. Study duration

The overall duration of the study was six months after the approval of the Departmental Review Board Committee (DRBC). The synopsis of the study was approved in

April 2025, and data collection was conducted from July 2024 to June 2025, assuring

representation of all four seasons of the year.

4.4. Sample Size

The sample size of the study was calculated using the WHO sample size calculator. Considering the limited number of availability of confirmed cardiac arrest cases and incomplete hospital records, the level of confidence and margin of error were adjusted to ensure feasibility. This resulted in a sample size of 69 patients, Sample Size Calculator (<https://www.calculator.net/sample-size-calculator.html>). The smaller sample size was justified due to (i) scarcity of confirmed cases, (ii) hospital-specific limitations, (iii) feasibility within the defined time frame, and (iv) cases that met the inclusion criteria of the study.

Small sample size was justified by a study titled “Sleep Disruption is Associated with Increased Ventricular Ectopy and Cardiac Arrest in Hospitalized Adults” having sample size 87.

4.5. Inclusion criteria

Patients with a confirmed diagnosis of cardiac arrest.

Patients aged 15 years or older.

Patients who were residents of Azad Jammu and Kashmir (AJK).

4.6. Exclusion criteria

Unconfirmed or suspected cases of cardiac arrest.

Patients aged below 15 years.

Patients not residents of AJK.

Patients with incomplete or missing medical records.

4.7. VARIABLES

4.7.1. Dependent Variable

Cardiac Arrest (frequency and occurrence).

4.7.2. Independent Variable

Circadian rhythm disruption (sleep–wake pattern disturbances, night-time wakefulness, shift in biological clock).

Circadian disruption was considered as an independent variable due to strong evidence from previous literature indicating that irregular sleep–wake cycles and disrupted 24 hours biological rhythms contribute significantly to cardiovascular instability and may contribute to cardiac arrest.

4.8 Sampling Technique

The study utilized a simple random sampling technique. A list of all eligible cases that meets the inclusion criteria of the study was prepared from the different departments of the hospital record registers of ER, CCU, and patient admission wards. After initial listening from the record, patients' files were assigned serial numbers, and a computer-based random number generator (randomizer) was used to select cases. This sample selection method ensured that every confirmed case of cardiac arrest had an equal chance of selection, thus minimizing selection bias in the sample.

4.9 Data Collection tool

Due to the unavailability of an open access standardized tool for data collection and lack of response from authors the data collection tool was adapted from the previously documented study “Circadian Variations and Associated Factors in Patients with Ischaemic Heart Disease.” The tool for data collection of this study was chosen because variables of this study were aligned with the objectives of present study. A systematic checklist and data extraction form were developed and then converted into a Google Form for systematic data entry of the record.

4.10 Data collection procedure

Data for present study was collected through secondary records of the hospital . The researchers visited ER, CCU, and wards daily and extracted information from patient record registers. A list of eligible patients was prepared, after which random selection was done using a Randomizer Number Generator, (<https://play.google.com/store/apps/details?id=com.zerosoftwares.randomizer>). The selected patients' files were reviewed, and relevant data were entered into a Google Form. Data collection spanned July 2024 to June 2025 to capture circadian variations across all 4 seasons of the year.

4.11 Data cleaning

Collected data were initially entered into Google Forms, then exported to Microsoft Excel for cleaning. Duplicate entries, incomplete records, and inconsistencies were removed before final analysis..

4.12 Data Analysis

The cleaned dataset was imported into SPSS (version 26) for statistical analysis. Descriptive statistics (mode) were used to summarize demographic variables. Inferential statistics, including chi-square tests and multinomial regression, was applied to assess associations between circadian rhythm disruption and cardiac arrest frequency. A p-value < 0.05 was considered statistically significant, (Source: IBM <https://share.google/LuB4hLl8xFfETdDGe>).

4.13 Ethical Consideration

The study was approved by the Institutional Review Board (IRB). Formal permission was obtained from the hospital administration, including the Medical Superintendent (MS) and ward in-charges. Patient confidentiality was strictly maintained; no identifying information was reported. Data was used only for research purposes. Results are presented in aggregate form without targeting any individual patient.

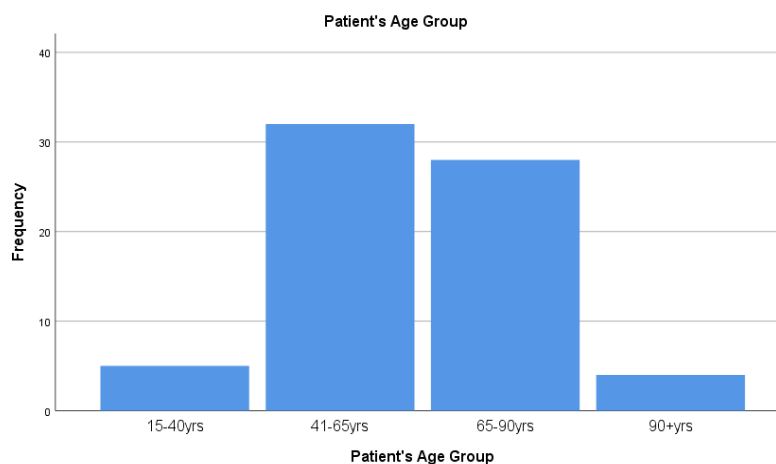
5. RESULTS

In this study, an overall of 69 confirmed cases of cardiac arrest were covered, of which 50 (72.5%) were male, 19 (27.5%) were female, with the most of patients (46.4%) falling with the age group of 41-65 years, followed by 40.6% in the age group of 65-90 years, 7.2% in the age group of 15-40 years and 5.8% aged above 90 years, majority of the participants were residents of district Muzaffarabad matched to other districts of Azad Kashmir. Analysis of the circadian distribution of cardiac arrest events showcase a clear early morning peak, with the peak frequency observed between 06 AM- 12 PM

(30.4%), followed by 12 AM-06 AM (23.2%), meanwhile not as many events occurred between 12 PM-06 PM (27.5%) and the lowest percentage was reported between 06 PM – 12 AM (18.8%). With respect to sleep-wake pattern, 48 (69.6%) patients had inconsistent sleep patterns, 21 (30.4%) patients reported no inconsistency, and a chi-square test shows a statistically notable association between circadian rhythm disruption and the timing of cardiac arrest ($\chi^2= 60.142, p < 0.001$). Seasonal analysis showed that the highest number of cases occurred in winter (44.9%), followed by the summer (23.2%), spring (15.9%) and autumn (15.9%), while weekday distribution showed that cardiac arrest was most persistent on Monday (24.6%) and least persistent on Friday (10.1%). Clinical characteristics of subjects showed that 29 patients (42%) had a pre-existing hypertension, 13 patients (18.8%) were diabetic, 20 (29%) patients suffered from angina, 1 patient (1.4%) were obese, 7 patients (10.1%) were smokers and alcohol use and hyperlipidemia were unknown. Outcomes of cardiac arrest showed that 68 patients (98.6%) died and 1 patient (1.4%) recovered.

Table No. 01: Distribution of Age group

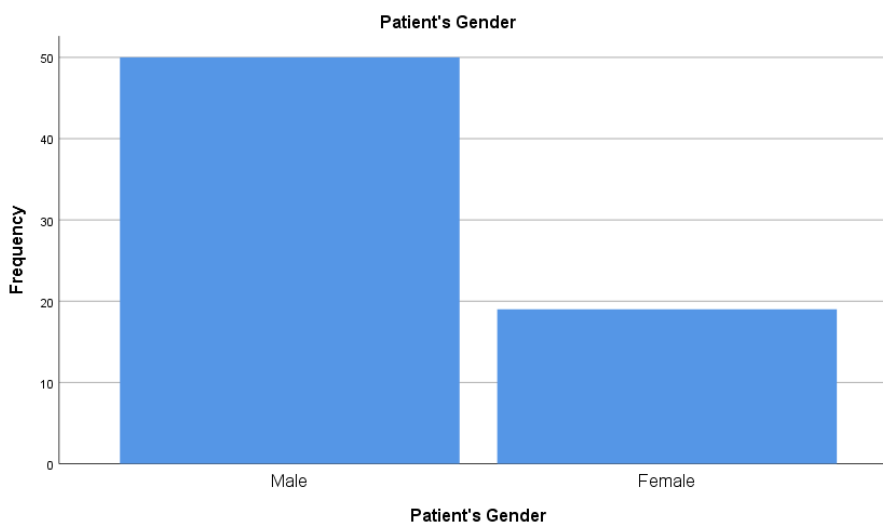
Patient's Age Group		Frequency	Percentage	Valid Percent	Cumulative Percent
Valid	15-40yrs	5	7.2	7.2	7.2
	41-65yrs	32	46.4	46.4	53.6
	65-90yrs	28	40.6	40.6	94.2
	90+yrs	4	5.8	5.8	100.0
	Total	69	100.0	100.0	



Explanation: The above table and chart show that from 69 participants, 7.2% belongs to age group 15-40yrs, 46.4% belongs to age group 41-65yrs, 40.6% belongs to age group 65-90yrs and 5.8% belongs to age group 90+yrs. Most of the participants belongs to age group 41-65 yrs.

Table No. 02: Patient's Gender
Patient's Gender

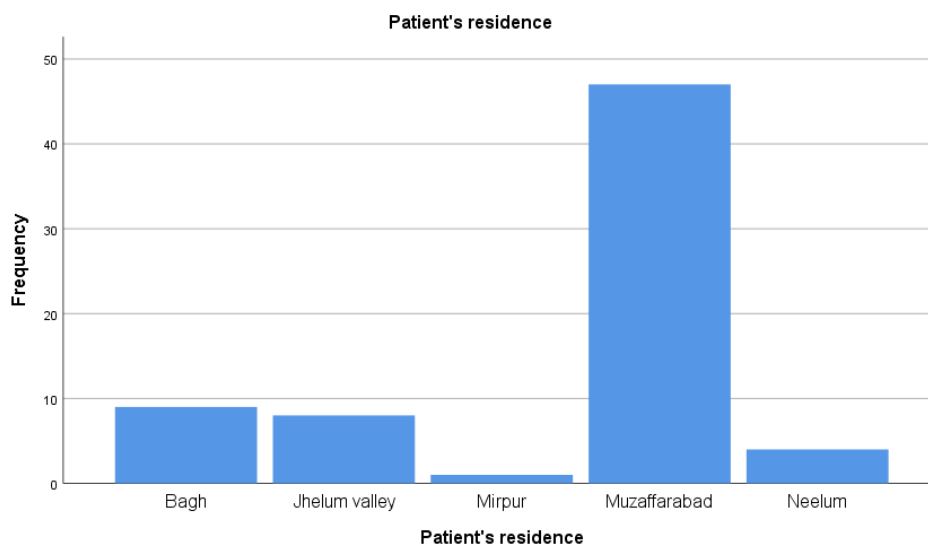
		F	P	Vali	Cum
		requency	ercent	d Percent	ulative Percent
Valid	Male	50	72.5	72.5	72.5
	Female	19	27.5	27.5	100.0
	Total	69	100.0	100.0	



Explanation: The above table and chart show that from 69 participants, 72.5% are male and 27.5% are females. Most of the participants are males.

Table No. 03: Patient's residence

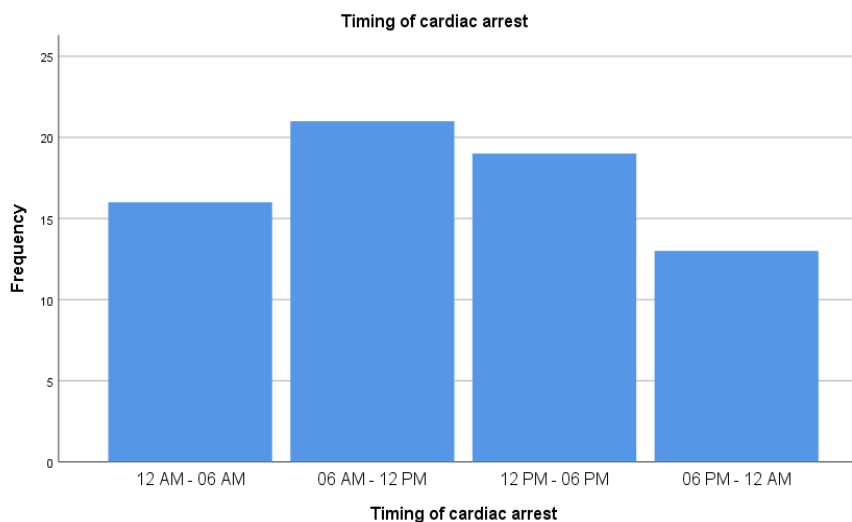
		F	P	Vali	Cum
		requenc	ercent	d Percent	ulative Percent
		y			
Valid	Bagh	9	13.0	13.0	13.0
	Jhelum valley	8	11.6	24.6	24.6
	Mirpur	1	1.4	26.1	26.1
	Muzaffarabad	47	68.1	94.2	94.2
	Neelum	4	5.8	100.0	100.0
	Total	69	100.0	100.0	



Explanation: The above table and chart show that from 69 participants, 13% belongs to district Bagh, 11.6% belongs to district Jhelum valley, 1.4% belong to district Mirpur, 68.1% belongs to district Muzaffarabad, and 5.8% belongs to district Neelum. Most of the participants belongs to district Muzaffarabad.

Table No. 04: Timing of cardiac arrest
Timing of cardiac arrest

	Frequency	F	Percent	P	Valid Percent	Cumulative Percent
Valid 12 AM - 06 AM	6	1	3.2	2	23.2	23.2
06 AM - 12 PM	1	2	0.4	3	30.4	53.6
12 PM - 06 PM	9	1	7.5	2	27.5	81.2
06 PM - 12 AM	3	1	8.8	1	18.8	100.0
Total	9	6	100.0	10	100.0	

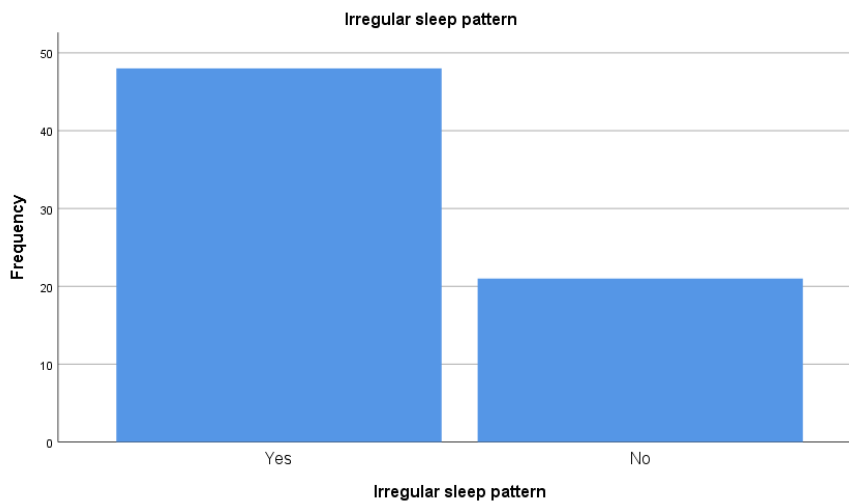


Explanation: The above table and chart show that from 69 participants, 23.2%

of the participants faced cardiac arrest between 12AM-06AM, 30.4% of the participants faced cardiac arrest between 06 AM - 12 PM, 27.5% of the participants faced cardiac arrest between 12 PM - 06 PM and 18.8% of the participants faced cardiac arrest between 06 PM - 12 AM. Most of the participants faced cardiac arrest between 06 AM - 12 PM.

Table No. 05: Irregular sleep pattern
Irregular sleep pattern

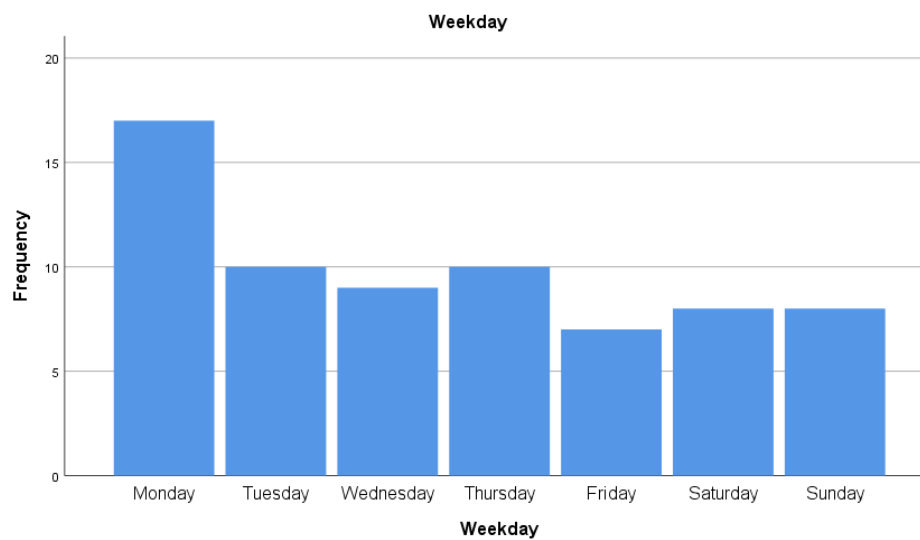
		F requency	P ercent	Valid Percent	Cum ulative Percent
Valid	Yes	48	69.6	69.6	69.6
	No	21	30.4	30.4	100.0
	Total	69	100.0	100.0	



Explanation: The above table and chart show that from 69 participants, 69.6% have irregular sleep pattern.

Table No. 06: Weekdays
Weekday

		F	P	Vali	Cum
		requency	ercent	d Percent	ulative Percent
Valid	Monday	17	24.6	2	24.6
	Tuesday	10	14.5	1	39.1
	Wednesday	9	13.0	1	52.2
	Thursday	10	14.5	1	66.7
	Friday	7	10.1	1	76.8
	Saturday	8	11.6	1	88.4
	Sunday	8	11.6	1	100.0
	Total	69	100.0	10	

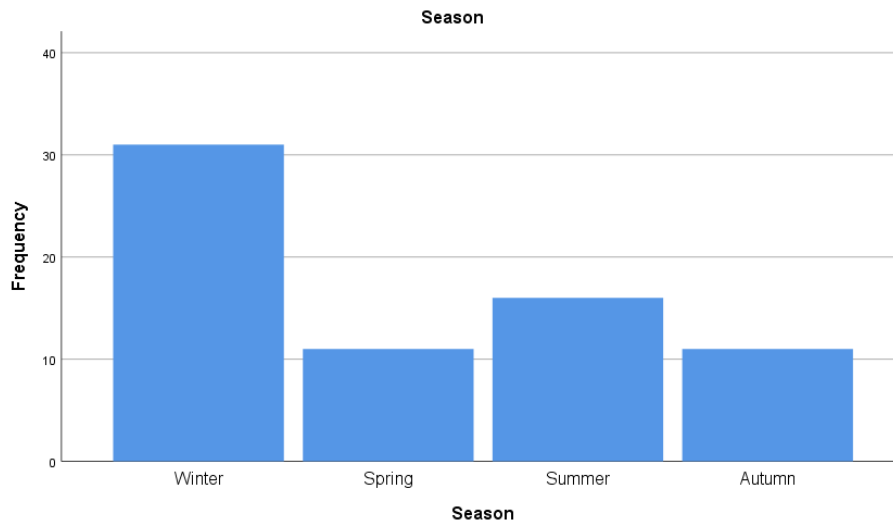


Explanation: The above table and chart show that from 69 participants, majority of the cases (24.6%) occurred on Monday and minority of the cases (10.1%) occurred on Friday.

Table No. 07: Season
Season

		F	P	Vali	Cum
		requency	ercent	d Percent	ulative Percent
Valid	Winter	3	4.9	4	44.9
	Spring	1	5.9	1	60.9

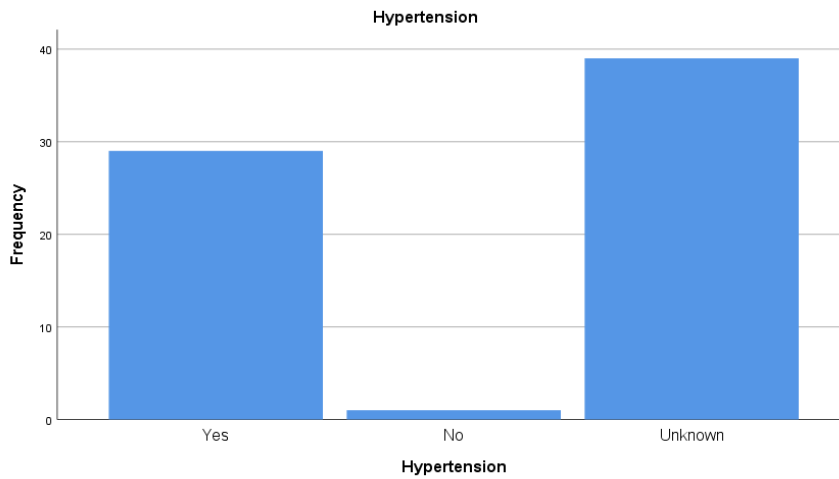
	S	1	2	23.2	84.1
ummer	6	3.2			
	A	1	1	15.9	100.
utumn	1	5.9			0
	T	6	1	100.	
otal	9	00.0	0		



Explanation: The above table and chart show that from 69 participants, majority of the cases (44.9%) occurred in Winter and minority of the cases (15.9%) occurred in Spring and Autumn.

Table No. 08: Hypertension
Hypertension

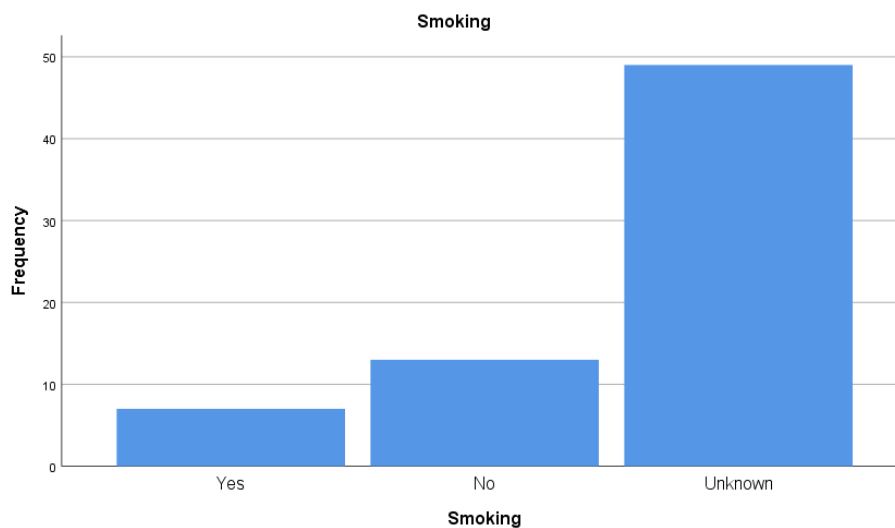
		F	P	Vali	Cum
		requency	ercent	d Percent	ulative Percent
alid	es	Y	2	4	42.0
		9	2.0		42.0
	o	N	1	1	1.4
			.4		43.5
nknown	U	3	5	56.5	100.
	9	6.5			0
otal	T	6	1	100.	
	9	00.0	0		



Explanation: The above table and chart show that from 69 participants, 42% of the participants have hypertension while 56.5% of the cases are unknown.

Table No. 09: Smoking

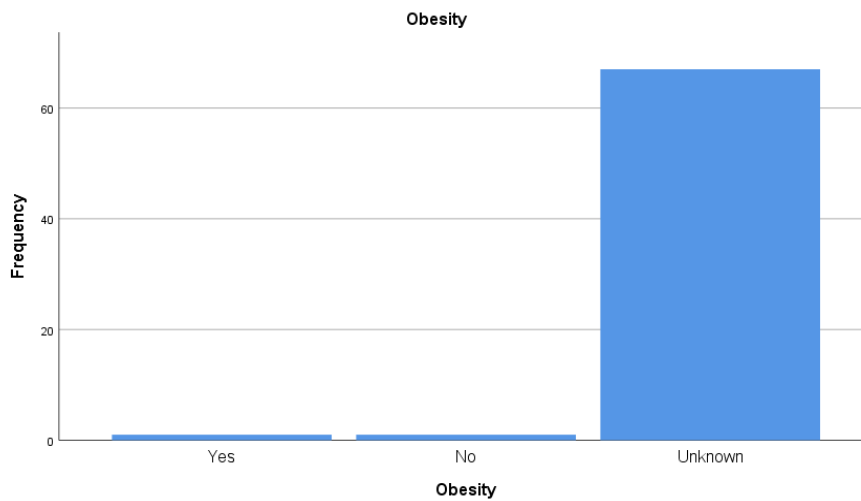
		F	P	Valid	Cum
		requency	ercent	d Percent	ulative Percent
Valid	Yes	7	10.1	10.1	10.1
	No	1	1.4	18.8	29.0
	Unknown	39	56.5	71.0	100.0
	Total	47	68.0	100.0	



Explanation: The above table and chart show that from 69 participants, 10.1% of the participants are smokers while 71% of the cases are unknown.

Table No. 10: Obesity

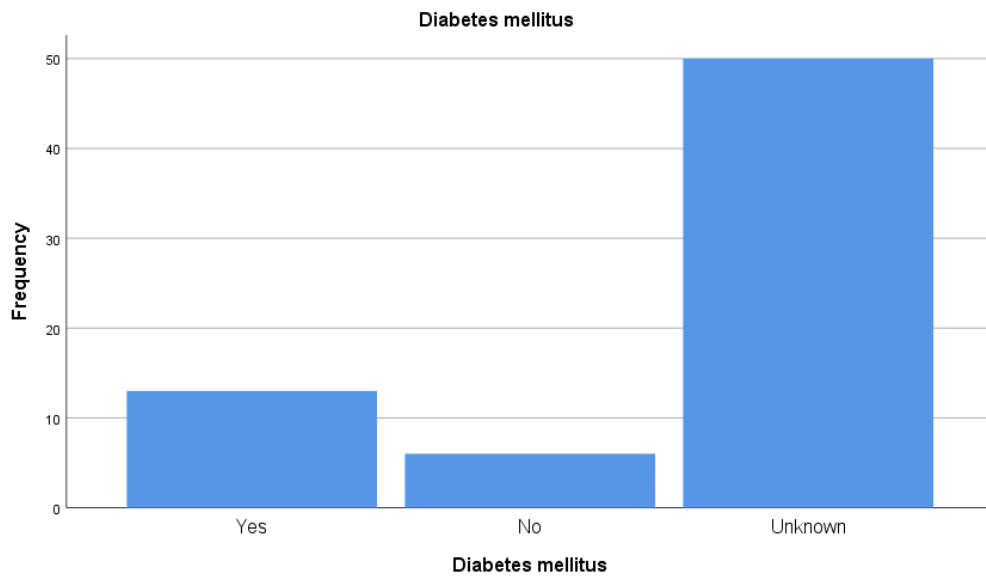
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	1.4	1.4	1.4
	No	1	1.4	1.4	2.9
	Unknown	67	97.1	97.1	100.0
	Total	69	100.0	100.0	



Explanation: The above table and chart show that from 69 participants, only 1.4% of the participants are obese while 97.1% of the cases are unknown.

Table No. 11: Diabetes mellitus
Diabetes mellitus

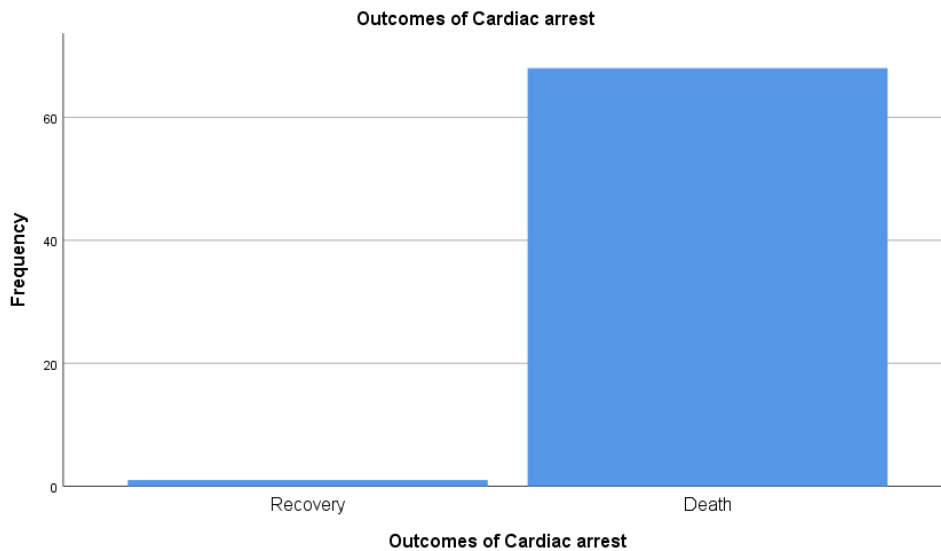
			F	P	Vali	Cum
			requency	ercent	d Percent	ulative Percent
Valid	Yes	Y	3	8.8	18.8	18.8
	No	N	6	8.7	8.7	27.5
	Unknown	U	0	2.5	72.5	100.0
	Total	T	9	100.0	100.0	



Explanation: The above table and chart show that from 69 participants, 18.8% of the participants have Diabetes Mellitus while 72.5% of the cases are unknown.

Table No. 12: Outcomes of Cardiac arrest
Outcomes of Cardiac arrest

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Recovery	1	1.4	1.4	1.4
	Death	68	98.6	98.6	100.0
	Total	69	100.0	100.0	



Explanation: The above table and chart show that from 69 participants, 1.4% participants are recovered from cardiac arrest. Majority of the participants are dead from cardiac arrest.

Table No. 13: Timing of cardiac arrest * Irregular sleep pattern Crosstabulation

Timing of cardiac arrest * Irregular sleep pattern Crosstabulation

		Irregular sleep pattern		Total
		Yes	No	
Timing of cardiac arrest	1 2 AM - 06 AM	16	0	16
	Expected Count	11.1	4.9	16.0
	% within Timing of cardiac arrest	100.0%	0.0%	100.0%
	% within Irregular sleep pattern	33.3%	0.0%	23.2%
0 6 AM -		20	1	21

12 PM	Expected Count	14.6	6.4	21.0
	% within Timing of cardiac arrest	95.2	4.8	100.
	% within Irregular sleep pattern	41.7	4.8	30.4
1 2 PM - 06 PM	Count	0	19	19
	Expected Count	13.2	5.8	19.0
	% within Timing of cardiac arrest	0.0	100.	100.
	% within Irregular sleep pattern	0.0	90.5	27.5
0 6 PM - 12 AM	Count	12	1	13
	Expected Count	9.0	4.0	13.0
	% within Timing of cardiac arrest	92.3	7.7	100.
	% within Irregular sleep pattern	25.0	4.8	18.8
Total	Count	48	21	69
	Expected Count	48.0	21.0	69.0
	% within Timing of cardiac arrest	69.6	30.4	100.
	% within Irregular sleep pattern	100.	100.	100.

Table No. 14: Chi-Square Test

		alue	V f	d	Asy mptotic Significance (2-sided)
Pearson Chi-Square		0.142^a	6	3	.000
Likelihood Ratio		9.710	6	3	.000
Linear-by-Linear Association		.221	9	1	.002
N of Valid Cases		9	6		

a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 3.96.

Explanation: A chi-square test shows a statistically notable association between circadian rhythm disruption and the timing of cardiac arrest ($\chi^2= 60.142$, $p < 0.001$).

6. DISCUSSION

This study showed the regularity and circadian design of cardiac arrest and its connection with circadian rhythm disruption between patients in Azad Jammu and Kashmir. The results disclosed that cardiac arrest events follow a unique sequential design, with a declared early hours and a strong connection with irregular sleep patterns. The results of the study confirm that disruption in the circadian rhythm plays an important role in the timing of occurrence and outcomes of cardiac arrests.

Demographic separation shows that the most number of cardiac arrest cases happened in males (72.5%) and those individuals aged between 41–65 years (46.4%). These results are relatable with previous international publications, which have also documented a higher frequency of cardiac arrest and other cardiac events in middle-aged and older men, most likely due to multiple cardiovascular risk factors like hypertension, diabetes, smoking, and alcohol.

The time-based results show the highest peak in frequency of cardiac arrests during 6:00 AM-12:00 PM (30.4%), indicating a strong surge in cardiac events in the early morning hours of the day. This is associated with the internal biological techniques of the circadian system that influence cardiac activity, as early morning hours surge is due influence of higher sympathetic nervous action, increased level cortisol, and elevated blood pressure after sleep. A secondary rise in cases is seen during 12:00 AM–6:00 AM which can possibly be relevant to disturbance of the sleep or inadequate sleep and nocturnal stress. These results of the present study are in alignment with previously documented studies (Muller et al., 1985); (Tsukada et al., 2010), which also declared early morning hours of the day as the most susceptible period for the occurrence of cardiac events.

An important statistical connection was observed between irregular sleep patterns and cardiac arrest happenings ($\chi^2 = 60.142$, $p < 0.001$). This shows that disturbance of Circadian cycles directly contributes to instability of the cardiovascular system and increased susceptibility to fatal arrhythmias. About 70% of patients do not have appropriate sleep patterns, showing the harmful cardiovascular impact of lifestyle-related circadian rhythm imbalance. The same results were documented, (Scheer et al.

2010), which proves the association between irregular sleep patterns and increased blood pressure, and irritating reactions to vulnerable populations and cardiac events.

Seasonal variations shows the greatest difference of cardiac arrests frequency in winter season (44.9%), followed by autumn (23.2%), with the lowest frequency of cases in summer season (14.5%). This pattern of occurrence of cardiac events totally resemble with internationally documented studies indicating that cold environmental temperatures cause vasoconstriction of the blood vessels, increased blood thickness due to less fluids consumption, and raised blood pressure, all these risk factors are contributing to an increased cardiac workload. Moreover, the weekly results of the frequency of study showed that Mondays (24.6%) had the highest figure of cardiac arrests, most likely associated to work-related stress, while Fridays (10.1%) showed the minimum frequency, mirroring a period of rest and lower psychological strain.

Clinically, hypertension (42%), angina (29%), and diabetes (18.8%) were the most habitual comorbidities. In any case, while field engagement, it was noted that brief patient histories were often not available at the time of urgent enrollment. Because cardiac arrest is a short-term urgency, healthcare providers emphasize cardiopulmonary resuscitation (CPR) for existence rather than history-taking. Staff from tertiary hospitals documented that due to the high patient load, gathering full clinical data was often not available. This limitation influences both clinical management and the exhaustiveness of research data.

To address this problem, it is strongly suggested that the health department expand a structured referral and data-sharing system among basic and tertiary healthcare facilities. Basic care staff should obtain patients' baseline histories and threat factors (through caregivers if necessary) and electronically share these documents when recommending patients to higher-level hospitals. This would allow emergency departments to retrieve vital context information quickly, enhancing patient results and supporting future research.

This study encounters some limitations. The sample size was comparatively small due to time restrictions and community reachability problem, which may limit the applicability of outcomes. The short time of the study also prohibited deeper trend investigated. furthermore, there was a lack of local literature on circadian rhythm-related cardiac diseases in Muzaffarabad, making it stimulating to contrast and interpret outcomes within the local population.

Regardless these hurdles, the results offer susceptible understanding into the local designs of cardiac arrests, highlighting the demand to acknowledge circadian rhythm disturbance as a developing cardiovascular threat factor.

Table No. 15: Comparison of Current Study with Previous Literature

Parameters / Findings	Current study	Previous study (e.g., Muller et al., 1985 & Tsukada et al., 2010)	Comparison summary
Peak time of Cardiac arrest	Morning (6:00 AM-12:00PM)- 30.4% Cases	Morning peak reported globally	Similar trend confirming morning surge in cardiac events
Secondary Peak	Early morning (12:00 AM-6:00AM)	Noted in the patients with sleep disorders	Supports link between sleep disruption and cardiac events
Gender Distribution	72.5% male	70-75% male	Consistent with previous

			evidence showing male predominance
Common Age group	41-65 years	40-65 years	Aligned with established high-risk age bracket
Sleep pattern association	69.6% had irregular sleep; strong association (p<0.001)	Irregular sleep linked to cardiovascular risk (Scheer et al., 2010)	Confirms circadian disruption as a significant risk factor
Seasonal Trend	Highest in winter (44.9%) and lowest in summer (14.5%)	Winter dominance reported globally	Consistent with previous evidence
Weekly pattern	Highest on Monday (24.6%), Lowest on Friday (10.1%)	Monday peaks report internationally (Willich et al., 1992)	Matches international trend due to work week stress
Comorbidities	Hypertension (42%), Angina (29%), Diabetes (18.8%)	Hypertension, Diabetes and smoking are most frequent	Comparable comorbidity distribution
Data limitations	Limited patient history due to emergency nature	Not widely discussed in older studies	Highlights a new contextual issue in local setup
Sample size/Scope	69 patients, limited duration	Large scale studies with >500 patients	Smaller sample size limit generalization but provides regional insights

The finding of the current study strictly harmonizes with prior international results. comparable to the studies by (Muller et al. 1985) and (Tsukada et al., 2010), a clear early hour's peak (6:00 AM–12:00 PM) in cardiac arrests was noticed, directing that the circadian system important impact the timing of cardiac events. Male prevalence (72.5%) and focus within the 41–65 age group also comprised cardiovascular epidemiology. Moreover, the noticed linkage among inappropriate sleep patterns and cardiac arrest strongly supports the results of Scheer et al. (2010), who proved that conflicting sleep timetables increase cardiovascular risk. The winter season and Monday apex reflects the global trends, endorsing the role of ecological and psychosocial stressors. Moreover, unlike prior large-scale studies, our study defined a crucial local problem: partial patient histories at the time of urgent enrollment due to the short-term nature of cardiac arrest and heavy hospital work pressure. This emphasizes the demand for better communication among basic and tertiary healthcare systems in the region.

7. CONCLUSION

This study investigated the cardiac arrest frequency and circadian distribution of cases and examined their association with circadian rhythm disruption among patients in Muzaffarabad, Azad Jammu and Kashmir. The results from this study

revealed that cardiac arrest events are not randomly distributed throughout the whole day but rather follow a specific temporal pattern that correlates strongly with the human internal 24 hours biological clock. The finding from the research provides valuable facts that disturbance of circadian rhythm vitally affects both the development and results of cardiac arrest, uplifting the need for including chronobiological context into results on cardiac health and medical intervention to prevent cardiac arrests.

The demographic findings demonstrated that cardiac arrest was more common in males (72.5%) as compared to females (27.5%), and the maximum number of cases were noticed in individuals between the ages of 41-65 years. This result coincides with the well-known pattern of the world that middle-aged and older males are more prevalent to cardiac events due to long term exposure to risk factors including high blood pressure, diabetes mellitus, and smoking. The higher male superiority also demonstrates the possible gender-based disparity in occupational stress, lifestyle factors, and hormonal protection in premenopausal women. Chronobiological analysis exposed a notable morning spike in cases of cardiac arrest between 6:00 AM to 12:00 PM (30.4%), with a secondary spike between 12:00 AM to 6:00 AM (23.2%). This outcome aligns with prior studies showing early-morning peaks in sympathetic tone, hypertension, and platelets aggregation all of which can affect acute or long term cardiac events. The noticeable morning peak of the cardiac arrest supports the hypothesis that circadian disturbance in cardiac physiology plays an important role in causing cardiac arrests.

A strong association was also found among irregular circadian rhythms and the occurrence of cardiac arrest ($\chi^2 = 60.142$, $p < 0.001$). Around 70% of patients reported disturbed sleep-wake rhythms, demonstrating that circadian imbalance can negatively affect cardiac health. The nominal regression further supported that patients with irregular sleep patterns were more prone to die after cardiac arrest than those with regular circadian rhythms. These outcomes are in alignment with global research showing that circadian disturbance elevated systemic inflammation, elevates cortisol levels, and disturbs cardiac autonomic balance, all of which contribute to higher cardiovascular mortality.

Seasonal and weekly patterns show that cardiac arrests were most prevalent in winter (44.9%) and least common in summer (14.5%), while Mondays (24.6%) dominated for the highest proportion of weekly cases. These patterns match with international research that work and psychosocial stress at the beginning of the week can affect cardiovascular risk. Such repetitive cardiac events patterns strengthen the effects of both environmental and behavioral factors on the timing of cardiac arrests.

The clinical features of the study population showed that hypertension (42%), angina (29%), and diabetes (18.8%) were the most commonly linked comorbidities, demonstrating their important role as predisposing factors for cardiac arrest. Yet, it was noticed that due to the emergency nature of

cardiac arrest, detailed patient data were often unavailable during initial hospital communication. Since patients with cardiac arrest need immediate Cardiopulmonary resuscitation (CPR), hospital staff have limited opportunity to gather detailed background data or history of the patient. Discussions with administration of hospitals revealed that high patient load on the hospital and insufficient primary documentation systems further restrict the ability to maintain complete medical records.

Given these obstacles, it is important that the Health department of Azad Jammu and Kashmir executes standardized protocols for inter-hospital collaboration and data transfer of patients digitally. Patients should firstly report to Primary Healthcare centers including BHUs and RHCs, where trained health professionals can gather essential medical histories or information regarding patients from attendants and digitally forward them to tertiary care hospitals during referrals. Such a strategy would not only improve emergency planning but also enhances research accuracy and continuity of care.

Regardless of its valuable contributions, this study faced certain constraints. The sample size ($n = 69$) was relatively small, mainly due to the short duration of the study and limited availability of data. As a result, the outcomes of the research may not be fully generalizable to the entire regional population. In addition, there was an observable lack of local literature on circadian-related cardiac events in Azad Jammu and Kashmir, complicating the establishment of long-term patterns or evaluations. However, the current study provides a significant foundation for future research into the temporal dynamics of cardiac events within this region of Azad Jammu and Kashmir.

In conclusion, the study shows that circadian rhythm disturbance is a crucial and independent contributing factor linked with the timing and outcomes of cardiac arrest. The noticeable early morning peak and strong association with irregular sleep-wake cycle highlights the critical function of biological variation in cardiovascular health. This shows the importance of promoting healthy sleep management, stress management, and chronobiological education in the community as part of preventive measures against cardiac arrest.

8. RECOMMENDATIONS

Concentrated on the outcomes of this study, multiple suggestions are designed to raise awareness, preventive strategies, and management of cardiac arrest linked with

circadian rhythm disturbance.. The results demonstrate a strong connection among disturbed sleep wake cycles and the timing and death of cardiac arrests, which featured the critical requirements for both healthcare system strengthening and public health interference.

Initially, there is a major request to improve patient information gathering and documentations management within healthcare services, throughout communication with hospital staff, it was detected that due to the urgency normal of cardiac arrest, there is often limited time to acquire a brief patient history, as the medical team's urgent attention is on cardiopulmonary resuscitation (CPR) and revitalization. To conquer this limitation, it is suggested that the Health Department of Azad Jammu and Kashmir develop a digital recommendation and record-sharing system linking primary, secondary, and tertiary healthcare centers. Primary healthcare staff should be accountable for gathering necessary patient data, such as comorbidities, sleep patterns, and lifestyle habits, via caregivers at the time of first contact. This information should then be electronically relocated to tertiary hospitals so that emergency staff have instant permission to pertinent context data. executing this system would increase both patient management and the quality of information accessible for research and monitoring objectives.

Secondly, the results show the significance of increasing public knowledge concerning circadian health and its role in cardiovascular prosperity. Public health administration should launch Knowledge campaigns targeting the sustainability of a healthy daily routine, sufficient sleep duration, and stress management as preventive approaches against heart related events. The people must be informed about how abnormal sleep patterns, late-night activities, and shift work can raise the vulnerability of heart attacks and cardiac arrest. Educational decisions can be incentives via hospitals, schools, media, and social networks to inspire healthier lifestyle methods and early medical discussion for individuals undergoing cardiac signs.

Thirdly, the reinforcement of preventive cardiology at the basic healthcare level is necessary. Basic health centers should be prepared to identify and observe communities at risk, specifically those with hypertension, diabetes, obesity, smoking habits, or irregular sleep schedules. Regular screening programs should be arranged to check blood pressure, blood sugar, and cardiac activity between high-risk populations. Furthermore, basic healthcare staff should be skilled and qualified to give lifestyle awareness and assure timely recommendations of critical patients to tertiary hospitals. This preventive strategy can play an important role in minimizing the load of cardiac

emergencies in the community.

Lastly, there is a strong demand to advertise further research on the association among circadian rhythm disturbance and cardiac events in the local background. Large-scale case-control and cohort studies should be organized to initiate causal relationships and define more threat factors related to the regional community. Future research should also involve negative populations and longer follow-up periods to increase the applicability of outcomes. Furthermore, collaborative research perspectives that merge circadian biology, cardiovascular medicine, and preventive medicine are supported to grow and expand balanced lifestyle approaches.

These ideas emphasize the significance of strengthening healthcare systems, boosting public awareness, enhancing early diagnosis, and encouraging creativity to deal with the elevated education of cardiac arrests associated with circadian rhythm disturbance. Applying these strategies will not only improve patient results but also take part in the advancement of more proactive, fact-based, and preventive healthcare strategies in Azad Jammu and Kashmir.

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