



## AN ESPECIALLY CONCERNING ISSUE WITH HYPERTENSION IS CIRCADIAN DISRUPTION

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### ABSTRACT

Circadian rhythms, which are vital to many physiological processes, are present in almost all human tissues and organs. Circadian rhythms are endogenous regulators that are involved in the regulation of physiological and behavioral processes. It allows organisms to adjust to changing ambient conditions. Circadian disturbances can result from exposure to light and other environmental stimuli that alter our internal, central, and peripheral clocks. The irregularity in these clocks may result in several health issues. One of the main risk factors for cardiovascular disease and a defining feature of cardiovascular dysregulation is hypertension. By determining likely chronotypes and other health indicators, researchers may be able to focus their attention on important mechanisms that underlie the adverse health outcomes. We provide a summary of the research that has been published showing a link between possible markers of circadian disruption and cardiometabolic outcomes with a focus on hypertension.

**KEYWORDS:** Circadian Rhythm, Biological Clocks, Peripheral Clocks, Circadian Disturbances Hypertension

Circadian rhythms, which are endogenous regulators, enable organisms to adapt to the shifting environmental conditions during a 24-hour period (Dibner *et al.*, 2010, Patke *et al.*, 2017). The primary function of the circadian system is to schedule physiological processes to predict times of activity and rest. These functions are governed by internal "clocks," of which the brain's suprachiasmatic nucleus, which acts as the centre of the clocks in almost every body tissue, contains one primary clock. The importance of these rhythms for health is demonstrated by the fact that clocks are present throughout the body (Ansu and Knuston; 2023). Good health depends on maintaining synchronization, which includes keeping all of our internal clocks in sync with the external world (Allada and Bass; 2021). The circadian rhythm—waking in the morning and sleeping in the evening—is a recurring pattern of behavior experienced by the human body.

Blood pressure in the cardiovascular system follows a pattern as well, rising throughout the day and falling at night. Furthermore, there are notable variations to this blood pressure pattern in cases of hypertension in humans. Blood pressure falls at night, rises in the morning, and then falls again in a 24-hour cycle when there is no illness present. It has long been recognized that circadian rhythms are a defining characteristic of both hypertension and blood pressure management (Rudic and Fulton; 2009). Acute and chronic medical

illnesses, as well as a variety of sleep disturbances, can also change blood pressure and result in hypertension (Smolensky *et al.*, 2007). Hypertension is a hallmark of cardiovascular dysregulation and a major risk factor for cardiovascular disease and mortality. When blood pressure is controlled with medication, the chance of a cardiovascular event can be greatly reduced (Staessen *et al.*, 2003, Messerli *et al.*, 2007, Collins *et al.*, 1990 and Staessen *et al.*, 2000). A major contributing element to the challenges in managing hypertension is a delay in diagnosis. Hypertension is not only underreported but can also be undiagnosed for technical reasons since people are unwilling to regularly check their blood pressure (Li and Wang; 2013, Cohen and Townsend; 2010).

Here we have summarized previously published observational data that have demonstrated that the following factors may have an adverse effect on cardiometabolic outcomes: chronotypes, shift workers who work nights or rotate shifts, irregular sleep patterns and sleep timing, and irregular meal times (Dibner *et al.*, 2010).

### NEGATIVE HEALTH OUTCOMES MAY BE A CONCERN ASSOCIATED WITH CIRCADIAN TYPE

Certain hypotheses suggest that evening chronotypes have a higher risk of developing metabolic syndrome and type 2 diabetes compared to morning

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chronotypes (Osonoi *et al.*, 2014, Wong *et al.*, 2015, and Yu *et al.*, 2015). According to one study, people with morning chronotypes had a higher incidence of type 2 diabetes whereas those with evening chronotypes had a lower incidence. One possible explanation is that morning chronotypes are more susceptible to biological cycle disruption from night shifts than evening chronotypes. On the other hand, morning shifts may cause a less severe disturbance of biological rhythms in those who are morning chronotypes.

The biological management of circadian rhythms depends on melatonin, an endogenous antihypertensive hormone that has been linked to depression (Jonas *et al.*, 2003). Patients with non-dipper hypertension have decreased melatonin secretion at night. Individuals who identify as evening chronotype are more prone to have disorders along with poor sleep quality and impulsivity (Selvi *et al.*, 2012, Stolarski *et al.*, 2013). Knutson *et al.* (2018) found that for individuals living in the United Kingdom, a later chronotype is linked to an increased risk of death from cardiovascular disease. With an average follow-up of 6.5 years and enrollment ages ranging from 38 to 73, they looked at 433-268 people. Initial reports of greater mortality in evening types are consistent with previous findings of higher levels of cardiometabolic risk factors in this group. Many of the behavioral, psychological, and physiological risk factors associated with evening chronotype may be associated with a long-term mismatch between an individual's internal physiological timing and the externally imposed time of social and professional activities. They suggested more research be done in order to fully comprehend the physiological repercussions of having an evening personality and to take the increased mortality risk into consideration. Understanding the relationship between chronotype and mortality could aid in the development of novel behavioral strategies to lessen the risk associated with being an evening person. Schedules should be customized to each individual's chronotype wherever possible as part of a plan that may also include medications that affect the circadian system (Roenneberg and Merrow; 2016, Knutson and Von Schantz; 2018, Makarem *et al.*, 2020). Studies indicate that individuals with an evening-oriented chronotype who work nights may be more vulnerable to the negative effects of night work on the cardiometabolic system. Future research on the connection between night work and cardiovascular disease should consider chronotype. If the association of chronotype with cardiovascular disease is confirmed, a

careful assessment of the chronotype might allow a tailored treatment of subjects with cardiometabolic diseases promoting an alignment of their daily activities according to their circadian rhythm (Rudic and Fulton; 2009, Smolensky *et al.*, 2007, Kecklund and Axelsson; 2016).

## **STRESS FROM SHIFT WORK MAY HARM ONE'S HEALTH**

In the round-the-clock world of today, shift work is essential. It is commonly known that shift work's long-term disturbance of circadian rhythms has been connected to detrimental health outcomes, such as cardiovascular disease and breast cancer (Gan *et al.*, 2015, Puttonen *et al.*, 2010, Vyas *et al.*, 2012, Wang *et al.*, 2013, Hulsege *et al.*, 2019). Shift work has been linked to various cardiometabolic risk factors such as uric acid, hypertension, and inflammatory markers (Hulsege *et al.*, 2019). Researchers discovered that shift workers did not exhibit an increased risk of cardiometabolic risk factors in this regard when compared to day employees; shift workers who worked evening chronotypes did, however, have a higher likelihood of being overweight (Vetter *et al.*, 2015). The typical sleep-wake cycle is disturbed by shift workers because they frequently have to sleep during the day, which throws off circadian rhythms and raises the risk of chronic illnesses (Ritonja *et al.*, 2018). There are certain cardiometabolic disease risk factors that have been linked to shift work. Women who worked rotating shifts had a higher cardiometabolic risk score, according to cross-sectional research of female hospital personnel. The score was derived from a composite of blood pressure, fasting blood glucose, triglycerides, and a measurement of the waist circumference. This study also showed variations in the 24-hour urinary cortisol production and a flatter 24-hour urinary cortisol production pattern in shift workers when compared to day workers over the course of two days of urine collection (Bloomfield and Park; 2015). The circadian regularity of blood pressure levels can be disturbed by shift employment, and both blood pressure levels and diurnal rhythms are significant factors in cardiovascular health. Because shift work, especially night shift work, occurs during a biological time (night) when blood pressure levels should be lower, blood pressure values are elevated during wake times, especially during work periods compared with non-work times. This can disrupt the normal diurnal blood pressure pattern and increase the risk of cardiovascular disease (CVD) (Abbott *et al.*, 2019).

## GETTING ENOUGH SLEEP IMPROVES HEALTH

Circadian disruption may result from sleep timing, or the time of day that sleep takes place, especially if it happens at a period that is contrary to the biological clock. Sleeping later has been linked to lower cardiometabolic health profiles, much like chronotype. For instance, late sleep/wake timing was linked to higher measured insulin resistance and higher systolic and diastolic blood pressure measurements in a sizable observational study of Hispanic/Latino people (Abbott *et al.*, 2019, Knuston *et al.*, 2017). Numerous measures have been devised to quantify the regularity of sleep. First, there's the idea of "social jet lag" (SJL), which describes fluctuations in sleep schedules between work/school and leisure days. Research has shown links between higher SJL and increased risk of cardiometabolic disease (Chaput *et al.*, 2020). For instance, one study discovered that higher SJL was linked to a higher frequency of metabolic syndrome and diabetes/prediabetes in younger persons (<61 years old), whereas no correlation was seen in older adults (Koopman *et al.*, 2017). The Sleep Regularity Index is another innovative metric that's utilized to measure the regularity of sleep. The Sleep Regularity Index calculates the likelihood that a person will be awake or asleep at the same two times, separated by 24 hours. Reduced values of the Sleep Regularity Index have been linked to poorer cardiometabolic outcomes, worse daytime functioning, and delayed circadian sleep/wake cycles. Consequently, these measurements could be helpful tools for describing how regularly people sleep (Philips *et al.*, 2017, Lunsford *et al.*, 2018, Murray *et al.*, 2019).

## DIET'S IMPACT ON CARDIOMETABOLIC ILLNESSES

Cardiometabolic disease management and prevention are greatly influenced by diet. While eating a balanced, high-quality diet is still vital for good health, there is growing emphasis on the significance of meal time. Since food synchronizes our peripheral clocks, the time of meals may have an impact on metabolic organ circadian rhythms. The benefits of meal timing—that is, the timing and duration of eating for cardiometabolic health have been shown by a recent study. As a result, there is now more interest in intermittent fasting as a nutritional strategy (Wehrens *et al.*, 2017, McHill *et al.*, 2017, McEvoy *et al.*, 2016, Harvie *et al.*, 2011, Meng *et al.*, 2020, Patterson *et al.*, 2015). A few times a week, or 1-3 days, there is a switch-off between regular eating times and periods of fasting when someone practices intermittent fasting. Time-restricted eating, or TRE, is a

type of intermittent fasting in which people eat within a window of 4 to 10 hours per day, limiting their intake of nutrients, without making a conscious effort to limit their calorie or food intake. According to certain research, TRE significantly improved blood pressure, insulin sensitivity, beta cell activity, body weight, and waist circumference (Chaix *et al.*, 2014, Sutton *et al.*, 2018).

## CONCLUSION

To sum up, to keep the human body's physiological functions under control, circadian rhythms are necessary. Circadian disturbance and cardiometabolic disorders have been linked in the last ten years, according to data from several observational studies. The public should be educated about the significance of circadian health to general health and well-being through the development of efficient distribution strategies in the future.

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