International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Operating Publisher
SciFormat Publishing Inc.
ISNI: 0000 0005 1449 8214

2734 17 Avenue SW,
Calgary, Alberta, T3E0A7,
Canada
+15878858911
editorial-office@sciformat.ca

ARTICLE TITLE	SHIFT WORK AND THE HEART: EFFECTS OF SHIFT WORK ON THE DEVELOPMENT AND PROGRESSION OF HEART FAILURE AND ITS ASSOCIATION WITH CHRONIC DISEASE RISKS - A NARRATIVE REVIEW
DOI	https://doi.org/10.31435/ijitss.1(49).2026.4641
RECEIVED	09 December 2025
ACCEPTED	16 January 2026
PUBLISHED	21 January 2026
LICENSE	The article is licensed under a **Creative Commons Attribution 4.0 International License.**

SHIFT WORK AND THE HEART: EFFECTS OF SHIFT WORK ON THE DEVELOPMENT AND PROGRESSION OF HEART FAILURE AND ITS ASSOCIATION WITH CHRONIC DISEASE RISKS - A NARRATIVE REVIEW

Natalia Nawrocka *(Corresponding Author, Email: natalia.nawr@gmail.com)*
J. Dietl Specialist Hospital in Cracow, Cracow, Poland
ORCID ID: 0009-0000-8593-0730

Filip Bednarek
St Anne's Hospital in Miechów, Miechów, Poland
ORCID ID: 0009-0008-5526-2426

Olga Plinta
Stefan Żeromski Specialist Hospital in Kraków, Cracow, Poland
ORCID ID: 0009-0003-2022-6920

Alicja Hojda
The University Hospital in Krakow, Cracow, Poland
ORCID ID: 0009-0002-8844-2542

Hanna Rodak
Szpital Zakonu Bonifratrów Św. Jana Grandego w Krakowie, Cracow, Poland
ORCID ID: 0009-0002-0444-4015

Izabela Małajewicz
Stefan Żeromski Specialist Hospital in Kraków, Cracow, Poland
ORCID ID: 0009-0005-7294-5059

Małgorzata Pietrzyk
The University Hospital in Krakow, Cracow, Poland
ORCID ID: 0009-0005-8193-0035

Dawid Stępień
Zespół Opieki Zdrowotnej Hospital in Dębica, Dębica, Poland
ORCID ID: 0009-0009-3374-2127

Karolina Oskroba
Stefan Żeromski Specialist Hospital in Kraków, Cracow, Poland
ORCID ID: 0009-0003-7169-2841

Igor Kłak
Private Health Care Facility Kraków – Południe, Cracow, Poland
ORCID ID: 0009-0005-3654-6755

ABSTRACT

Background: Shift work is increasingly prevalent worldwide as continuous service delivery becomes essential across sectors such as healthcare, transportation and industry. However circadian misalignment, sleep disruption, metabolic alterations and neurohormonal dysregulation make shift workers a population at heightened cardiometabolic risk. While the associations between shift work, hypertension and coronary artery disease (CAD) are well documented, its potential contribution to the development of heart failure (HF) remains less clearly defined.
Objectives: This narrative review synthesises current evidence on the impact of shift work - particularly night work and rotating schedules - on cardiovascular health with a focus on HF, CAD and hypertension. It contextualises HF risk within the broader metabolic and behavioural consequences of circadian disruption and identifies gaps in existing research.
Methods: A comprehensive review of epidemiological, clinical and experimental studies was conducted with emphasis on cardiometabolic pathways linking shift work to adverse cardiovascular outcomes.
Results: Shift work is consistently associated with an increased risk of hypertension and CAD with risk rising in proportion to cumulative exposure. Pathophysiology includes chronic sympathetic activation, inflammation, oxidative stress, hormonal dysregulation and frequent co-occurrence of unhealthy sleep, dietary and activity patterns. Evidence linking shift work to HF is more limited but suggests an elevated risk - particularly among women and permanent night-shift workers. Proposed mechanisms include chronic haemodynamic stress, myocardial fibrosis (supported by experimental models) and indirect effects mediated by worsened metabolic health. Heterogeneity in exposure definitions and inadequate adjustment for confounders remain key limitations of existing studies.
Conclusions: Shift work should be considered as an important, modifiable cardiovascular risk factor that may contribute not only to hypertension and CAD but also to HF development. Preventive strategies - including optimisation of shift schedules, adequate recovery periods and education targeting sleep hygiene, diet and physical activity - may mitigate these risks. Well-designed prospective studies with HF as a primary endpoint, detailed exposure assessment and phenotype-specific analyses are urgently needed. Greater awareness of the cardiovascular consequences of shift work is essential for clinicians, employers and public health policymakers.

KEYWORDS

Heart Failure, Shift Work, Ischemic Heart Disease, Night Work, Hypertension

CITATION

Natalia Nawrocka, Filip Bednarek, Olga Plinta, Alicja Hojda, Hanna Rodak, Izabela Małajewicz, Małgorzata Pietrzyk, Dawid Stępień, Karolina Oskroba, Igor Kłak. (2026) Shift Work and the Heart: Effects of Shift Work on the Development and Progression of Heart Failure and Its Association With Chronic Disease Risks – A Narrative Review. *International Journal of Innovative Technologies in Social Science*. 1(49). doi: 10.31435/ijitss.1(49).2026.4641

Shift Work as a Growing Public Health Concern: Cardiovascular Context and Rationale for the Review

The modern labor market is characterized by a growing prevalence of shift-based employment, encompassing work during afternoon, evening and night hours. This phenomenon is a direct consequence of the increasing demand for round-the-clock availability of essential services such as healthcare, public transportation and retail trade. Ensuring the continuous operation of these sectors requires the constant presence of personnel, which in turn necessitates the organization of work in a shift system. However, such a work arrangement is associated with significant health consequences, particularly in relation to disturbances of circadian rhythm, sleep quality, metabolic functions and hormonal regulation. Epidemiological data indicate that up to 20% of the global workforce is engaged in shift work and this proportion has shown a rising trend over recent decades [1].

Cardiovascular diseases remain one of the leading causes of death worldwide, posing a substantial burden on healthcare systems and economies. Population aging, prolonged survival of patients due to therapeutic advances and the increasing prevalence of risk factors all contribute to the growing healthcare and resource demands associated with these conditions. Among them, chronic heart failure (HF) holds particular significance: its increasing incidence and high mortality rate make it one of the most serious challenges in contemporary cardiology. Consequently, the identification and analysis of potential modifiable risk factors - such as exposure to shift work - have gained special importance in the context of both primary and secondary prevention.

Nevertheless, studies investigating the relationship between shift work and the risk of developing heart failure remain limited and the available systematic reviews have primarily focused on broader cardiovascular outcomes, such as coronary artery disease, hypertension and cardiac arrhythmias.

The aim of this paper is to review the scientific literature on the impact of shift work on the risk of heart failure and to place this association within the broader context of cardiovascular and metabolic disorders related to shift-based employment.

Overview of Heart Failure: Pathophysiology and Clinical Burden

Heart failure (HF) is a clinical syndrome characterised by symptoms such as dyspnoea, peripheral oedema, fatigue and reduced exercise tolerance, resulting from anatomical and/or functional abnormalities of cardiac performance leading to impaired tissue perfusion. The condition encompasses a wide spectrum of phenotypes, including heart failure with reduced ejection fraction (HFrEF), preserved ejection fraction (HFpEF) and mildly reduced ejection fraction (HFmrEF), which differ in their pathophysiological mechanisms, prognosis and response to treatment.

HF represents a major public health issue, placing a considerable burden on both patients and healthcare systems due to its high prevalence, substantial mortality and frequent hospitalisations. It is estimated that tens of millions of people worldwide are affected and the prevalence continues to rise with population ageing, improved survival following acute cardiovascular events (such as myocardial infarction) and advances in pharmacological and device-based therapies. Although these developments have positively influenced life expectancy, they have also contributed to increasing healthcare expenditures associated with long-term treatment, costly cardiac procedures and recurrent hospitalisations due to disease exacerbations [2,3,4].

A number of risk factors for the development of HF have been identified, modification of which may delay symptom onset or slow disease progression. The most important include hypertension, coronary artery disease, diabetes mellitus, obesity, smoking, valvular heart disease and advanced age [3]. Given the scale of the problem and the complexity of its underlying mechanisms, further investigation of emerging environmental and behavioural factors - such as exposure to shift work - remains essential in order to improve preventive strategies.

In the early stages, HF is often asymptomatic and may coexist with other cardiovascular conditions such as hypertension or coronary artery disease. As the disease progresses, symptoms develop that limit exercise tolerance and in advanced stages, also impair resting function. The most common manifestations include exertional and resting dyspnoea, fatigue, lower-limb oedema, orthopnoea and paroxysmal nocturnal dyspnoea. These symptoms are the main reasons for patients seeking medical attention. Fatigue is among the most frequent and distressing symptoms, significantly affecting daily functioning and quality of life [5]. Chronic physical limitations are also associated with an increased prevalence of mood disorders, including depression, anxiety and sleep disturbances [6].

Diagnosis of HF is based on a thorough clinical evaluation, echocardiographic assessment of cardiac function and laboratory testing, among which the measurement of N-terminal pro–B-type natriuretic peptide (NT-proBNP) levels holds particular diagnostic importance.

Therapeutic management of HF aims both to slow disease progression and improve prognosis, as well as to alleviate symptoms. Simultaneous treatment of coexisting cardiovascular and metabolic conditions is crucial for optimising therapeutic outcomes. Pharmacological therapy includes angiotensin-converting enzyme inhibitors (ACEIs), angiotensin receptor blockers (ARBs), beta-blockers, mineralocorticoid receptor antagonists (MRAs), angiotensin receptor–neprilysin inhibitors (ARNIs) and sodium–glucose cotransporter 2 (SGLT2) inhibitors. These drugs not only improve outcomes in HF but also benefit the management of hypertension and diabetes - conditions that significantly increase HF risk. In cases of conduction abnormalities or arrhythmias, device-based therapy such as implantation of cardioverter-defibrillators (ICD) or cardiac resynchronisation therapy (CRT) may be employed to enhance systolic function, reduce symptoms and improve quality of life.

Despite significant therapeutic advances, heart failure remains a condition with a substantial epidemiological and societal burden. Symptoms such as dyspnoea and fatigue markedly limit daily functioning and rates of hospitalisation and mortality in this population remain high [7]. Consequently, future preventive efforts should focus not only on improving treatment but also on identifying and modifying environmental and behavioural factors that may influence the risk and course of HF, such as shift work. Early identification of individuals at risk and implementation of targeted preventive measures may help reduce healthcare system burden and improve patients' quality of life.

Shift Work and Heart Failure: Epidemiological Evidence and Pathophysiological Mechanisms

The relationship between shift work particularly night work and the risk of developing heart failure remains relatively poorly understood. Most existing studies have focused on broader cardiovascular outcomes, such as coronary artery disease, hypertension or cardiac arrhythmias. In some analyses, HF was included as a secondary endpoint; however, evidence suggests that permanent night work may increase the risk of HF in women and this association persisted after adjustment for age and lifestyle factors [8].

A dose–response relationship has also been observed between the extent of exposure to night or shift work and the incidence of HF, with genetic predisposition appearing to modify this risk. Both long-term night work and a high genetic risk profile have been shown to mutually reinforce the association between shift work and HF. Other studies have confirmed that shift work is associated with an increased risk of HF even after controlling for socioeconomic and occupational variables such as age, sex, education level, working hours, physical workload, standing posture, smoking and dietary habits [9]. Furthermore, it has been suggested that in individuals without pre-existing cardiovascular disease or arrhythmias, the association between shift work and HF may be less pronounced [10].

Several pathophysiological mechanisms have been proposed to explain the potential impact of shift work on the development of heart failure. Disruption of circadian rhythm leads to chronic activation of the sympathetic nervous system, resulting in increased haemodynamic load and adverse myocardial remodelling. Moreover, individuals engaged in shift work often exhibit an unfavourable cardiometabolic profile characterised by higher body mass index, impaired glucose and lipid metabolism, poorer sleep quality and elevated stress levels [11]. Experimental animal studies have demonstrated that exposure to irregular activity–rest cycles, mimicking shift work conditions, induces increased expression of type I collagen and myocardial fibrosis, which may represent a pathophysiological substrate for the development of HF [12].

In summary, the available evidence suggests a possible association between shift work and an increased risk of heart failure-particularly among women and those working permanent night shifts. However, current findings remain limited and inconsistent. There is also evidence that extending recovery intervals between consecutive night shifts, as well as implementing preventive measures such as proper sleep hygiene and promotion of healthy lifestyle behaviours, may mitigate the adverse effects of circadian disruption [13].

It should be noted that the definition and classification of shift work exposure vary across studies, making direct comparison and interpretation of findings challenging. Further prospective studies are required, in which HF would serve as a primary endpoint, with comprehensive adjustment for potential confounders such as comorbidities and lifestyle factors. Additionally, studies distinguishing HF phenotypes (e.g., preserved vs. reduced ejection fraction) and interventional studies assessing the impact of modified work schedules on cardiovascular risk are warranted.

From a clinical perspective, it is important that physicians and specialists involved in the management of heart failure consider exposure to shift work as a potential risk factor—particularly among women performing night shifts. Workplace-based preventive strategies, including the reduction of night shift frequency, health education, improvement of sleep quality and body weight management, may play a role in lowering HF risk and improving the cardiometabolic health of shift workers.

Shift Work as a Risk Factor for Coronary Artery Disease

Exposure to shift work - particularly schedules involving nighttime hours - may impose a significant burden on the cardiovascular system. In recent years, numerous analyses have demonstrated that individuals working in shift-based systems exhibit an increased risk of developing coronary artery disease (CAD). Epidemiological data support the hypothesis that shift work may serve as an independent risk factor for CAD, with risk rising proportionally to the duration of exposure. Each additional year of shift work has been shown to be associated with a statistically significant increase in the risk of ischemic heart disease [14].

Moreover, shift work not only elevates the risk of cardiovascular events but is also linked to increased cardiovascular mortality, with this relationship becoming more pronounced with long-term exposure [15]. Compared with individuals working exclusively daytime schedules, shift workers display a significantly higher risk of coronary events [16].

The mechanisms underlying these associations are multifactorial and include circadian misalignment, chronic sympathetic nervous system activation and adverse metabolic alterations such as obesity, dyslipidaemia and insulin resistance. Additionally, these factors combined with poor sleep quality and chronic psychological stress may contribute to the progression of atherosclerosis, plaque instability and the occurrence of acute coronary syndromes.

From a clinical standpoint, incorporating shift work history into cardiovascular risk assessment appears justified, particularly among individuals with additional CAD risk factors. Importantly, not only the presence but also the characteristics of shift work may be relevant - duration of exposure, schedule regularity and the proportion of night shifts. Due to substantial heterogeneity in the definition of shift work and limited control of confounding variables in existing research, further prospective studies are needed with precise exposure measurement, stratification by demographic and occupational characteristics (e.g., age, sex, profession) and evaluation of mediating factors such as sleep, diet and physical activity.

In the context of CAD prevention, these findings highlight the need to implement strategies aimed at mitigating the negative health impacts of shift work. Such interventions include reducing the number of night shifts, extending recovery periods between consecutive shifts, regular monitoring of metabolic and cardiovascular parameters (blood pressure, lipid profile, glucose levels, body weight) and lifestyle-focused health education targeting diet, physical activity and sleep hygiene.

Hypertensive Risk in Shift Workers

Shift work leads to desynchronization of the circadian rhythm and represents a form of chronic physiological stress. One of the potential consequences of this disruption is an increase in arterial blood pressure and a heightened risk of developing hypertension. A growing body of literature has examined whether individuals working in shift-based systems exhibit higher systolic and diastolic blood pressure values, as well as a greater prevalence of diagnosed hypertension, compared with daytime workers. Studies have shown that individuals engaged in permanent night shifts present with significantly elevated systolic and diastolic blood pressure, whereas among rotating-shift workers, the primary abnormality appears to be increased systolic blood pressure [17]. Additional evidence indicates that both rotating schedules and permanent night work are associated with an increased risk of hypertension, particularly in individuals who complete a high proportion of night shifts [18,19]. Notably, even a single night shift has been reported to cause an increase in blood pressure assessed through 24-hour ambulatory blood pressure monitoring (ABPM) [20].

The pathophysiological mechanisms underlying these associations include chronic sympathetic nervous system activation, increased catecholamine release and hormonal axis dysregulation driven by circadian misalignment. Furthermore, shift workers more frequently experience irregular and poor-quality sleep, as well as inconsistent meal timing, which may contribute to the development of obesity and insulin resistance—well-established risk factors for hypertension. The absence of a physiological nocturnal decline in blood pressure ("non-dipping") is additionally linked to adverse cardiovascular prognosis.

From a clinical perspective, shift workers should be considered a population at elevated risk for hypertension, warranting regular blood pressure monitoring, ideally through 24-hour ABPM. In the context of

occupational medicine, strategies that reduce the physiological burden of irregular schedules may be beneficial, including limiting the number of night shifts, reducing the frequency of rotation and ensuring adequate rest intervals between shifts. Education targeting sleep hygiene, healthy dietary habits and physical activity may further mitigate the adverse cardiovascular effects of shift work.

Given the limitations of existing studies—including substantial heterogeneity in the definition of shift work and insufficient control of confounding variables—well-designed cohort and interventional studies are needed. Such research should account for both the type and duration of exposure, as well as objective pathophysiological indicators, including circadian blood pressure profiles (ABPM), hormonal markers and assessments of sympathetic nervous system activity.

Conclusions

Shift work, driven by the increasing demand for around-the-clock operation across multiple economic sectors, is associated with significant circadian desynchronization and numerous metabolic and cardiovascular consequences. Sleep disturbances, chronic sympathetic activation, dysregulation of hormonal axes and a higher prevalence of adverse cardiometabolic profiles place shift workers at particularly elevated risk for developing cardiovascular diseases.

To date, the most robust evidence links shift work with the development of hypertension and coronary artery disease—two major risk factors for heart failure. Studies indicate that both long-term night work and rotating schedules are associated with increased blood pressure and a higher incidence of coronary events, with risk escalating alongside cumulative exposure. Because hypertension and coronary artery disease are key determinants of myocardial injury, the hypothesis that shift work may indirectly contribute to the development of heart failure is biologically plausible.

In the available literature, the relationship between shift work and heart failure is less clearly defined, primarily due to the limited number of studies and substantial variation in how exposure is characterized. Nonetheless, some analyses suggest an increased risk of heart failure, particularly among women and individuals working permanent night shifts. Potential mechanisms include chronic hemodynamic overload, myocardial fibrosis observed in experimental models and indirect effects mediated through worsening metabolic profiles.

From a clinical perspective, shift work should be considered a potential risk factor not only for coronary artery disease and hypertension but - given their central role in the pathogenesis of heart failure - also for heart failure itself. Monitoring cardiometabolic parameters, optimizing work schedules and implementing preventive strategies targeting sleep, diet and physical activity may help mitigate the adverse effects of circadian disruption. Still, further prospective studies are required in which heart failure is evaluated as a primary endpoint, with consideration of disease phenotypes and risk-modifying factors.

This paper summarizes the current state of knowledge regarding the impact of shift work—particularly night work and rotating schedules - on cardiovascular health, with a specific focus on heart failure, coronary artery disease and hypertension. Epidemiological data and meta-analytical evidence presented herein indicate that shift work represents a significant yet underrecognized risk factor for chronic disease, including cardiovascular conditions.

Heart failure continues to be a growing public health challenge, characterized by increasing prevalence, substantial morbidity and high mortality. Its development is strongly associated with traditional risk factors such as hypertension, coronary artery disease, diabetes, obesity and metabolic disturbances. At the same time, emerging evidence suggests that environmental and occupational exposures - including shift work - may play an important role in modulating the risk and progression of these conditions.

Analyses indicate that shift work is associated with an elevated risk of ischemic heart disease, leading to higher incidence of coronary events and myocardial infarction. Mechanistic pathways underlying these associations include circadian disruption, chronic sympathetic activation, increased inflammation and oxidative stress, hormonal disturbances and frequent coexistence of unhealthy sleep, dietary and physical activity patterns.

Similarly, for hypertension, scientific evidence demonstrates that shift work is associated with a modest but consistent increase in both systolic and diastolic blood pressure, as well as a higher risk of developing hypertension as a chronic condition. This effect is particularly pronounced among individuals working systems involving night shifts, long-term rotation, or abrupt changes in the sleep–wake cycle. Phenomena such as loss of physiological nighttime dipping or heightened sympathetic activity likely play key roles in this process.

The presented evidence suggests that shift work should be considered a significant, modifiable cardiovascular risk factor. Consequently, preventive strategies are needed, including organizational interventions (optimizing shift schedules, ensuring adequate rest periods) and employee education on sleep hygiene, healthy nutrition and regular physical activity. Occupational health services should incorporate shift work exposure into risk assessments and monitor shift workers for early signs of cardiovascular dysfunction.

In conclusion, current evidence clearly indicates that shift work adversely affects cardiovascular health, increasing the risk of hypertension, coronary artery disease and potentially heart failure. However, further well-designed studies are required to precisely assess the impact of shift work duration and type on cardiovascular outcomes and to develop optimal preventive strategies. The findings presented in this review underscore the need for heightened awareness of these risks among employees, employers and healthcare professionals.

Disclosure:

Author Contributions

Conceptualization Natalia Nawrocka, methodology Filip Bednarek, check Olga Plinta, formal analysis Igor Kłak, investigation Alicja Hojda, resources Hanna Rodak, data accuration Izabela Małajewicz, writing Natalia Nawrocka rough preparation Dawid Stępień, review and editing Karolina Oskroba, visualization Natalia Nawrocka, supervision Małgorzata Pietrzyk, project administration Natalia Nawrocka.

All authors have read and agreed with the published version of the manuscript.

Funding Statement: The study did not receive any special funding.

Acknowledgments: Artificial intelligence (AI) was used only for language enhancement purposes, such as grammar correction and stylistic refinement.

Conflict of Interest: All authors declare no conflict of interest.

REFERENCES

1. Wu, Q.-J., et al. (2022). Shift work and health outcomes: An umbrella review of systematic reviews and meta-analyses of epidemiological studies. *Journal of Clinical Sleep Medicine, 18*(2), 653–662. https://doi.org/10.5664/jcsm.9642
2. Shahim, B., Kapelios, C. J., Savarese, G., & Lund, L. H. (2023). Global public health burden of heart failure: An updated review. *Cardiac Failure Review, 9*, Article e05. https://doi.org/10.15420/cfr.2023.05
3. Groenewegen, A., Rutten, F. H., Mosterd, A., & Hoes, A. W. (2020). Epidemiology of heart failure. *European Journal of Heart Failure, 22*(8), 1342–1356. https://doi.org/10.1002/ejhf.1858
4. Virani, S. S., et al. (2021). Heart disease and stroke statistics—2021 update. *Circulation, 143*(8), e254–e743. https://doi.org/10.1161/CIR.0000000000000950
5. Pavlovic, N. V., et al. (2022). Fatigue in persons with heart failure: A systematic literature review and meta-synthesis using the biopsychosocial model of health. *Journal of Cardiac Failure, 28*(2), 283–315. https://doi.org/10.1016/j.cardfail.2021.07.005
6. Al-Sutari, M. M., & Abdalrahim, M. S. (2024). Symptom burden and quality of life among patients with heart failure. *SAGE Open Nursing, 10*, 23779608241242023. https://doi.org/10.1177/23779608241242023
7. Jones, N. R., Roalfe, A. K., Adoki, I., Hobbs, F. D. R., & Taylor, C. J. (2019). Survival of patients with chronic heart failure in the community: A systematic review and meta-analysis. *European Journal of Heart Failure, 21*(11), 1306–1325. https://doi.org/10.1002/ejhf.1594
8. Xu, C., et al. (2022). Shift work, genetic factors, and the risk of heart failure. *Mayo Clinic Proceedings, 97*(6), 1134–1144. https://doi.org/10.1016/j.mayocp.2021.12.003
9. Ho, F. K., et al. (2022). Association and pathways between shift work and cardiovascular disease: A prospective cohort study of 238,661 participants from UK Biobank. *International Journal of Epidemiology, 51*(2), 579–590. https://doi.org/10.1093/ije/dyab144
10. Wang, N., et al. (2021). Long-term night shift work is associated with the risk of atrial fibrillation and coronary heart disease. *European Heart Journal, 42*(40), 4180–4188. https://doi.org/10.1093/eurheartj/ehab505
11. Ho, F. K., et al. (2022). Association and pathways between shift work and cardiovascular disease: A prospective cohort study of 238,661 participants from UK Biobank. *International Journal of Epidemiology, 51*(2), 579–590. https://doi.org/10.1093/ije/dyab144
12. Trott, A. J., et al. (2022). Lack of food intake during shift work alters the heart transcriptome and leads to cardiac tissue fibrosis and inflammation in rats. *BMC Biology, 20*(1), Article 58. https://doi.org/10.1186/s12915-022-01256-9

13. Brum, M. C. B., Senger, M. B., Schnorr, C. C., Ehlert, L. R., & Rodrigues, T. da C. (2022). Effect of night-shift work on cortisol circadian rhythm and melatonin levels. *Sleep Science, 15*(2), 143–148. https://doi.org/10.5935/1984-0063.20220034
14. Cheng, M., et al. (2019). Shift work and ischaemic heart disease: Meta-analysis and dose–response relationship. *Occupational Medicine, 69*(3), 182–188. https://doi.org/10.1093/occmed/kqz020
15. Xi, J., Ma, W., Tao, Y., Zhang, X., Liu, L., & Wang, H. (2025). Association between night shift work and cardiovascular disease: A systematic review and dose-response meta-analysis. *Frontiers in Public Health, 13*, Article 1668848. https://doi.org/10.3389/fpubh.2025.1668848
16. Torquati, L., Mielke, G. I., Brown, W. J., & Kolbe-Alexander, T. (2018). Shift work and the risk of cardiovascular disease: A systematic review and meta-analysis including dose–response relationship. *Scandinavian Journal of Work, Environment & Health, 44*(3), 229–238. https://doi.org/10.5271/sjweh.3700
17. Gamboa Madeira, S., Fernandes, C., Paiva, T., Santos Moreira, C., & Caldeira, D. (2021). The impact of different types of shift work on blood pressure and hypertension: A systematic review and meta-analysis. *International Journal of Environmental Research and Public Health, 18*(13), Article 6738. https://doi.org/10.3390/ijerph18136738
18. Ferguson, J. M., et al. (2019). Night and rotational work exposure within the last 12 months and risk of incident hypertension. *Scandinavian Journal of Work, Environment & Health, 45*(3), 256–266. https://doi.org/10.5271/sjweh.3788
19. Manohar, S., Thongprayoon, C., Cheungpasitporn, W., Mao, M. A., & Herrmann, S. M. (2017). Associations of rotational shift work and night shift status with hypertension. *Journal of Hypertension, 35*(10), 1929–1937. https://doi.org/10.1097/HJH.0000000000001442
20. Seward, S. L., Kishman, E. E., Rynders, C. A., & Broussard, J. L. (2025). Acute night shift work is associated with increased blood pressure and reduced sleep duration in healthy adults. *Physiological Reports, 13*(3), Article e70231. https://doi.org/10.14814/phy2.70231