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Effects of Shift Work on Selected Health Aspects

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ABSTRACT

Background:

Shift work, particularly night work, is associated with circadian misalignment, sleep disruption, and impaired physiological recovery. Previous studies have suggested links between shift work and multiple chronic health conditions, including cardiovascular diseases, metabolic disorders, mental health disturbances, and selected cancers.

Aim:

The aim of this review is to synthesize the evidence contained in the reviewed literature regarding the effects of shift work on four selected health domains: cancers, cardiovascular diseases, metabolic disorders, and mental health.

Methods:

A narrative review methodology was applied. A critical review of the literature was conducted, based on leading scholarly publications in the field. The review included meta-analyses, prospective cohort studies, narrative reviews, and mechanistic studies addressing shift work and selected health outcomes.

Results:

The strongest and most consistent evidence concerned cardiovascular and metabolic outcomes. Shift work was associated with increased risks of myocardial infarction, ischemic stroke, coronary events, metabolic syndrome, diabetes mellitus, overweight, obesity, and cardiometabolic multimorbidity. Mental health studies indicated increased risks of depressive symptoms, anxiety, and poor mental health, particularly among women and workers with shift work disorder. Cancer-related findings were less consistent. Breast cancer risk appeared elevated after prolonged exposure to rotating night shifts in some studies, whereas other prospective analyses found little or no overall association. Evidence regarding prostate cancer was largely inconclusive. Across all domains, the proposed mechanisms included circadian disruption, sleep deprivation, hormonal imbalance, inflammatory activation, oxidative stress, and psychosocial strain.

Conclusions:

Shift work has meaningful adverse effects on selected aspects of health, with the strongest evidence observed for cardiovascular and metabolic disorders. Mental health consequences, particularly depressive symptoms, are also supported by the literature. Cancer associations remain biologically plausible but epidemiologically inconsistent. The reviewed evidence supports considering shift work as a chronic biological and behavioral stressor requiring preventive occupational-health strategies and more individualized exposure assessment.

Key words:

shift work; night work; cardiovascular diseases; metabolic disorders; mental health; cancer; circadian disruption; sleep deprivation

1. INTRODUCTION

Shift work is defined as work performed outside conventional daytime hours, commonly including evening work, night work, rotating schedules, and other non-standard arrangements. In this literature, the core problem is not merely working “late,” but the chronic mismatch between work timing and human circadian organization. James et al. (2017) framed shift work primarily as sleep displacement and circadian misalignment, while Kecklund and Axelsson (2016) emphasized the downstream combination of short sleep, fatigue, and insufficient physiological recovery. Wang et al. (2011) similarly described shift work, especially night

work, as a candidate risk factor for several chronic diseases through circadian disruption, altered behavior, and psychosocial stress.

The articles also show that the concept of “shift work” is methodologically unstable. Some studies define exposure as any non-day schedule, others isolate rotating night shifts, permanent night work, or broad “ever exposed” categories, and still others emphasize duration or frequency. This variability is not a minor technical detail. Several of the analyzed reviews identify exposure heterogeneity as a major reason why the evidence can look strong in one synthesis and equivocal in another, especially in cancer epidemiology. The same issue applies to outcomes: some articles examine incidence, others mortality, others pooled vascular events, and mental-health studies often rely on symptom scales rather than clinical diagnoses (Wang et al., 2011; „Carcinogenicity of night shift work”, 2019; Rivera-Izquierdo et al., 2020; Travis et al., 2016).

The aims of the present review are therefore deliberately bounded. It focuses exclusively on four outcome domains: cancers, cardiovascular diseases, metabolic disorders, and mental health. The resulting manuscript is not a de novo systematic review of the world literature; rather, it is a restricted synthesis of the evidence contained in the reviewed literature. This narrowed scope is justified by the extensive and continuously expanding body of scientific literature on shift work and its health consequences, which makes it impractical to address all potentially relevant outcomes within a single review. Given the breadth of available evidence, any attempt to comprehensively cover the entire field would risk superficial treatment of individual topics. In my view, the selected domains represent some of the most important and clinically relevant areas requiring discussion, as they encompass major causes of morbidity, reduced quality of life, and long-term public health burden. Focusing on these outcomes allows for a more coherent and meaningful synthesis of the reviewed literature while maintaining a clear and manageable analytical framework. Nevertheless, other health-related consequences of shift work, including sleep disturbances, gastrointestinal disorders, reproductive health, immune function, occupational accidents, and social disruption, also remain important areas of inquiry. These issues may interact with the outcomes discussed in this review and contribute to the broader health burden associated with irregular work schedules. Further research is therefore needed to examine these additional domains in greater depth and to clarify their relationship with different patterns of shift work.

Research Objective. The research objective of this review is to synthesize the evidence from the reviewed literature regarding the effects of shift work on four selected health domains: cancers, cardiovascular diseases, metabolic disorders, and mental health.

Research Problems. The study examined whether shift work, particularly night work, is associated with adverse health outcomes in the areas of cancer, cardiovascular diseases, metabolic disorders, and mental health. It also explored the biological and behavioral mechanisms linking shift work with these health consequences, including circadian disruption, sleep deprivation, hormonal imbalance, inflammatory activation, oxidative stress, and psychosocial strain.

Research Hypotheses. Shift work is associated with selected health outcomes, including cancers, cardiovascular diseases, metabolic disorders, and mental health problems. The strength, consistency, and possible mechanisms of these associations may differ across individual outcome domains and types of evidence reviewed.

2. METHODS

A narrative review methodology was adopted for the purposes of this study. The methodological approach was based on a critical analysis of the existing scientific literature, with particular emphasis on leading scholarly publications in the field. The reviewed material included meta-analyses, prospective cohort studies, narrative reviews, and mechanistic studies addressing the relationship between shift work and selected health outcomes. This approach enabled a structured synthesis of current knowledge while allowing for the interpretation and comparison of findings from different types of scientific evidence.

The synthesis prioritized three levels of evidence. First, pooled estimates from systematic reviews and meta-analyses were used to summarize the direction and approximate magnitude of associations. Second, prospective cohort studies were used to anchor site-specific or clinically concrete findings, especially for breast cancer, cardiovascular mortality, and cardiometabolic multimorbidity. Third, broader reviews were used to integrate mechanisms and explain why effects might differ across disease domains. Because several reviewed meta-analyses likely drew on overlapping primary studies, the pooled estimates should not be interpreted as independent replications; they represent partially overlapping summaries of the same wider literature.

3. RESEARCH RESULTS

Across the analyzed reviews, shift work is best understood not as a single exposure but as a cluster consisting of night-time light exposure, circadian misalignment, truncated or displaced sleep, altered meal timing, reduced social synchrony, and cumulative recovery failure. Faraut

et al. (2013), James et al. (2017), Wang et al. (2011), and Kecklund and Axelsson (2016) all converged on variants of this model. In that shared framework, disease does not arise simply because work occurs at night; it arises because physiology, behavior, and social time become chronically decoupled.

Table 1. Simplified model of mechanisms linking shift work with selected health outcomes.

Exposure	Main mediating disturbances	Potential health outcomes
Shift and night work	Circadian desynchronization; sleep shortening and fragmentation; disturbances in meal timing; weakened social synchrony and accumulation of insufficient recovery	Cardiovascular diseases, obesity, metabolic syndrome, diabetes, depressive and anxiety symptoms, and in some models also carcinogenic processes
Work during the biological night	Disturbances in autonomic and hormonal balance; inflammatory activation; oxidative stress; melatonin suppression; dysregulation of clock genes and cell-cycle control	Increased cardiometabolic burden, deterioration of mental health, and a biologically plausible, though epidemiologically less conclusive, risk of selected cancers

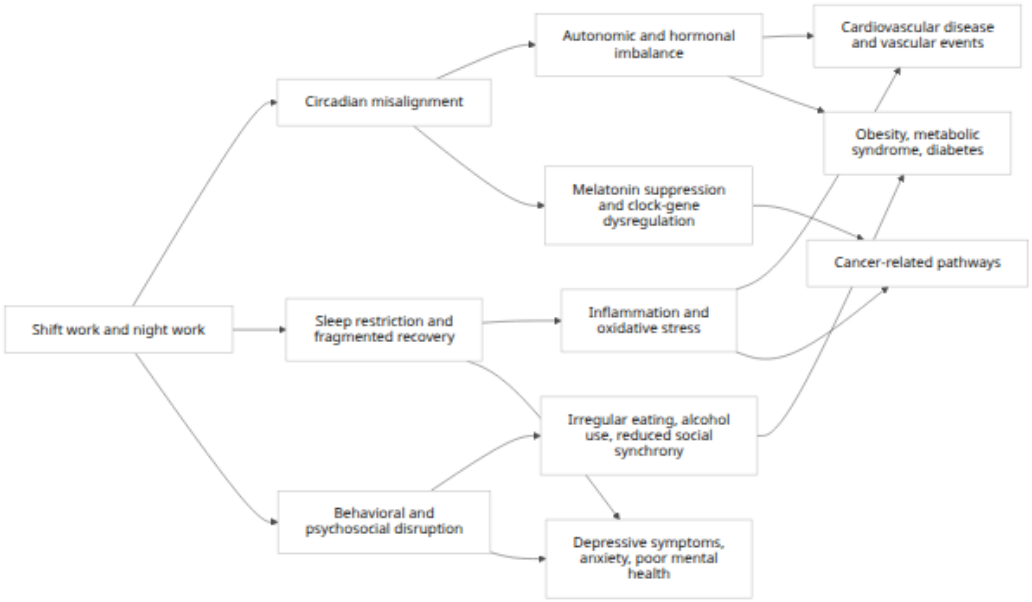

Figure 1. Potential mechanisms linking shift work and night work with selected health outcomes.
Source: Own elaboration based on the reviewed literature.

This mechanism map summarizes the recurring pathways described in the attached mechanistic and cross-domain reviews: sympathovagal and hormonal imbalance, inflammatory activation, oxidative stress, impaired glucose regulation, altered cell-cycle control, and psychosocial strain. Importantly, the same core pathway set appears to feed multiple endpoints, which helps explain why cardiometabolic disease, mood symptoms, and some cancer hypotheses recur together in the shift-work literature (Faraut et al., 2013; James et al., 2017; Kecklund & Axelsson, 2016).

3.1. Cancers.

The cancer evidence in the reviewed articles is broader in biological plausibility than in epidemiological consistency. Wang et al. (2011) concluded that the evidence was suggestive but not conclusive for breast cancer and limited or inconsistent for cancers at other sites. The IARC-linked 2019 report sharpened the language but not the certainty of the human data: the Working Group retained night shift work in Group 2A, "probably carcinogenic to humans," while explicitly labeling the human evidence as limited for breast, prostate, and colorectal cancer. That distinction matters. Within the searched literature, carcinogenic classification is not equivalent to strong epidemiological proof of a large risk in humans; rather, it reflects a combined judgment from human, animal, and mechanistic evidence (Wang et al., 2011; „Carcinogenicity of night shift work", 2019).

Breast cancer is the best-developed site-specific cancer outcome in the reviewed papers, but even here results are not fully aligned. Schernhammer et al. (2001) reported a statistically significant exposure-duration trend in the Nurses' Health Study, with the strongest elevation among women who had worked rotating night shifts for at least 30 years. By contrast, Travis et al. (2016), using three large prospective cohorts and a meta-analysis of 10 prospective studies, found combined relative risks essentially centered on the null for any night shift work and for long-duration exposure. Read together, these papers suggest that if a breast-cancer signal exists, it is probably not large, universal, or easy to detect with coarse exposure measures. It may instead depend on exposure intensity, timing in the reproductive life course, or other dimensions of schedule history that are inconsistently measured across studies (Schernhammer et al., 2001; Travis et al., 2016; „Carcinogenicity of night shift work", 2019).

The studied prostate-cancer literature also argues against a simple causal narrative. Rivera-Izquierdo et al. (2020) found no confirmed overall association between rotating/night-shift work and prostate cancer, and the pooled estimate moved closer to the null when the analysis was restricted to cohort studies or to higher-quality studies. This directly parallels the methodological concern emphasized in the IARC report: exposure assessment varies substantially between studies, and more weakly measured cohorts may dilute or distort the association. Also notable is the distinction between incidence and mortality. Gu et al. (2015) did not find significantly increased total cancer mortality in U.S. nurses with rotating night shifts, although they did observe a modest increase in lung cancer mortality after very long exposure. In the reviewed studies, then, cancer appears as the most uncertain

domain: biologically plausible, important enough to warrant continued surveillance, but not supported by uniformly positive epidemiological findings (Rivera-Izquierdo et al., 2020; „Carcinogenicity of night shift work", 2019; Gu et al., 2015).

3.2. Cardiovascular diseases.

In contrast to cancer, the cardiovascular evidence is substantially more coherent. The large meta-analysis by Vyas et al. (2012) showed increased risk of myocardial infarction, ischemic stroke, and coronary events among shift workers, even though pooled mortality effects were not clearly elevated. Wang et al. (2018) then added a dose-response perspective, showing that cardiovascular risk rose incrementally with duration of shift-work exposure, with a 5% increase in overall CVD risk and a 6% increase in CVD morbidity for every 5 additional years of shift work. Kecklund and Axelsson (2016) treated these cardiovascular estimates as among the more stable chronic-disease associations in the field (Vyas et al., 2012; Wang et al., 2018; Kecklund & Axelsson, 2016).

Mortality findings are somewhat less uniform than event-based findings, but they still lean adverse. Vyas et al. (2012) did not find a general increase in vascular mortality, whereas Wang et al. (2018) estimated a modest positive dose-response for cardiovascular mortality, and Gu et al. (2015) observed higher CVD mortality among nurses with at least 5 years of rotating night-shift work. These papers are not necessarily contradictory. They examine different populations, use different exposure definitions, and pool different outcome structures. The more defensible synthesis is that incident vascular events are the most consistently elevated cardiovascular endpoint, while mortality is also plausibly increased but is more sensitive to study design and case mix (Vyas et al., 2012; Wang et al., 2018; Gu et al., 2015).

Yang et al. (2022) extend the cardiovascular story in an especially clinically relevant way. Rather than looking only at first vascular events in otherwise mixed populations, they studied 36,939 UK Biobank participants who already had hypertension and asked whether shift work accelerated progression to cardiometabolic multimorbidity. Usually or always working night shifts was associated with a 16% higher risk of cardiometabolic multimorbidity, and more frequent night work was more strongly associated with risk. Equally important, the association was amplified when frequent night work occurred together with a morning chronotype or with short or long sleep duration. This finding is clinically important because it implies that exposure dose alone may not be enough to identify risk; vulnerability may depend on how the schedule interacts with biological preference and actual sleep behavior (Yang et al., 2022).

The mechanistic literature in the analysed papers makes the cardiovascular pattern intelligible. Faraut et al. (2013) described shift work as a state of chronic neuroendocrine, immune, and oxidative stress. James et al. (2017) emphasized sympathovagal imbalance, inflammation, and hormonal dysregulation. Kecklund and Axelsson (2016) linked shift-work effects to the same pathways implicated in insufficient sleep, arguing that the cardiovascular burden of shift work is at least partly mediated

through acute sleep loss and incomplete recovery. Taken together, the studied literature support the view that cardiovascular disease is one of the best-established medical consequences of shift work (Faraut et al., 2013; James et al., 2017; Kecklund & Axelsson, 2016).

3.3. Metabolic disorders.

The reviewed literature is especially persuasive in the metabolic domain because it covers several connected endpoints rather than a single disease label. Wang et al. (2014) found that night shift work was associated with a substantially increased risk of metabolic syndrome, with even higher pooled risk in workers with longer exposure. Gan et al. (2015) found a smaller but still significant increase in diabetes risk overall, with stronger effects in men and in rotating-shift schedules. Liu et al. (2018) and Sun et al. (2017) both concluded that shift work or night shift work was associated with greater risk of overweight and obesity. In other words, the attached corpus captures the entire metabolic spectrum: adiposity, abdominal obesity, dysglycemia, diabetes, and metabolic syndrome (Wang et al., 2014; Gan et al., 2015; Liu et al., 2018; Sun et al., 2017).

Several details in these meta-analyses are analytically important. First, metabolic risk appears schedule-sensitive rather than merely binary. Sun et al. (2017) reported greater risk for abdominal obesity than for other obesity phenotypes and found stronger associations in permanent night workers than in rotating shift workers. By contrast, Gan et al. (2015) found that rotating shifts were especially adverse for diabetes risk. That difference suggests that "metabolic risk" is not a single exposure-outcome pathway. Adiposity may be shaped strongly by chronic meal-timing disruption and long-term circadian inversion, whereas diabetes risk may be especially sensitive to rotating schedules that repeatedly prevent adaptation. Second, longer exposure mattered. Wang et al. (2014) reported higher metabolic syndrome risk with longer duration of night work, supporting a cumulative-burden model rather than a short-term transient effect (Sun et al., 2017; Gan et al., 2015; Wang et al., 2014).

The broader reviews explain why these effects may be especially pronounced metabolically. James et al. (2017) described impaired glucose metabolism, hormonal imbalance, altered appetite regulation, and mistimed eating as central consequences of circadian misalignment. Kecklund and Axelsson (2016) similarly argued that relations between shift work and cardiometabolic disease mirror those seen with insufficient sleep. Faraut et al. (2013) added inflammatory and oxidative mechanisms, while Yang et al. (2022) showed that high-frequency night work in hypertensive adults may contribute to combined cardiometabolic outcomes rather than isolated single diseases. The metabolic evidence is therefore not only statistically positive but also biologically integrated (James et al., 2017; Kecklund & Axelsson, 2016; Faraut et al., 2013; Yang et al., 2022).

3.4. Mental health.

Mental health represents an important dimension of the health consequences associated with shift work, as irregular working hours may disrupt sleep, recovery, circadian regulation, and social functioning. These factors can contribute to psychological strain and may increase vulnerability to depressive symptoms, anxiety, and reduced overall mental well-being. In this context, the relationship between shift work and mental health has become an increasingly relevant area of occupational health research.Torquati et al. (2019) pooled seven longitudinal studies and found that shift work was associated with increased adverse mental-health outcomes overall and with depressive symptoms specifically. Their gender analysis is one of the strongest findings in the mental-health scope: female shift workers showed a notably higher likelihood of depressive symptoms than female non-shift workers, and gender explained much of the between-study heterogeneity. This suggests that mental-health effects may be more context-dependent, sex-specific, or socially mediated than cardiovascular or metabolic effects (Torquati et al., 2019).

Booker et al. (2019) sharpened the clinical interpretation by focusing on shift work disorder among nurses rather than on schedule assignment alone. Nurses at high risk of shift work disorder had substantially worse depression and anxiety scores than those at low risk, and depression together with years of shift work predicted sickness absence. This is an important conceptual shift. Some workers may tolerate non-standard schedules relatively well, whereas others develop a syndrome of circadian and sleep misalignment severe enough to produce clinically meaningful psychological symptomatology. In that sense, shift work disorder may function as a proximal phenotype that helps explain why some epidemiological studies of "shift work" alone show stronger or weaker associations with mental health (Booker et al., 2019).

The mechanistic and psychosocial reviews support that interpretation. James et al. (2017) emphasized mood and social disorders among the downstream consequences of circadian misalignment, while also describing reduced opportunities for social support and work-life balance. Kecklund and Axelsson (2016) treated depression as part of the broader sleep-loss consequence spectrum. The reviewed mental-health literature therefore suggests that shift work affects mental health through both biological and psychosocial pathways: sleep loss and circadian misalignment on one side, and social isolation, schedule-family conflict, and reduced recovery opportunities on the other. The main evidence signal centers on depressive symptoms rather than on a broad range of psychiatric diagnoses (James et al., 2017; Kecklund & Axelsson, 2016; Torquati et al., 2019).

4. DISCUSSION AND LIMITATIONS

Taken together, the analysed literature support a graded interpretation of the health consequences of shift work. Within the studied literature, cardiovascular disease and metabolic disorders show the most consistent adverse associations. Mental-health outcomes also trend adversely, especially depressive symptoms and especially in women or workers with probable shift work disorder. Cancer remains the least settled domain: biologically plausible and still concerning enough to justify a carcinogenic classification in the IARC framework, yet epidemiologically inconsistent when assessed through prospective incidence studies alone (Vyas et al., 2012; Wang et al., 2018; Wang et al., 2014; Gan et al., 2015; Torquati et al., 2019; Travis et al., 2016; „Carcinogenicity of night shift work", 2019).

A major strength of the analysed papers is that independent-looking literatures converge mechanistically. Faraut et al. (2013), James et al. (2017), and Kecklund and Axelsson (2016) all identify disrupted circadian timing, sleep loss, inflammatory activation, autonomic imbalance, and endocrine dysregulation as recurring pathways. This cross-domain convergence matters because it helps explain why shift work is associated with clusters of outcomes rather than isolated conditions. The Yang et al. (2022) study is particularly important in that respect: it moves the field beyond single-endpoint models and shows how shift work may accelerate progression toward cardiometabolic multimorbidity in already vulnerable patients.

The limitations of this review arise not only from the characteristics of the available literature but also from the broad and multidimensional nature of the topic, as shift work may affect numerous other aspects of individual health beyond the outcomes discussed in this manuscript. First, the evidence base is dominated by reviews and meta-analyses, many of which overlap in their underlying primary studies; therefore, the appearance of repeated confirmation should be interpreted with caution. Second, shift-work exposure is inconsistently defined across studies: permanent night work, rotating night shifts, broad shift schedules, ever/never exposure, intensity, and duration are often combined, making direct comparisons difficult. Third, some domains are well represented in terms of outcomes but remain limited in construct diversity. Metabolic disorders are covered by several quantitative syntheses, whereas mental health is represented mainly by depressive symptoms and anxiety scales, and cancer primarily by breast and prostate cancer outcomes. Fourth, occupational distributions are uneven. Nurses and healthcare workers are prominent in several reviewed studies, which improves relevance to clinical occupations but may limit generalizability to other professional groups. Fifth, some findings differ by sex, chronotype, and sleep duration, suggesting that average pooled effects

may obscure vulnerable subgroups (Wang et al., 2011; „Carcinogenicity of night shift work", 2019; Travis et al., 2016; Torquati et al., 2019; Yang et al., 2022).

These limitations also help explain why the cancer literature looks weaker than the cardiovascular and metabolic literature. Cardiovascular events and metabolic outcomes are relatively proximate to sleep loss, autonomic imbalance, and altered eating or activity patterns, and therefore may emerge more readily even with imperfect exposure assessment. By contrast, cancer develops over longer time horizons, is strongly site-specific, and is more vulnerable to exposure misclassification, survival bias, and incomplete lifetime schedule reconstruction. The gap between the positive trend in Schernhammer et al. (2001) and the null pooled prospective estimate in Travis et al. (2016) is therefore not merely statistical; it reveals how sensitive cancer inference is to study design.

The clinical and occupational implications of the reviewed papers are nevertheless substantial. The strongest immediate justification for surveillance lies in cardiovascular and metabolic health: blood pressure control, glycemic monitoring, waist and weight trends, and broader cardiometabolic risk assessment are all reasonable priorities in night workers, especially those with long duration or high frequency of exposure, and especially in workers already living with hypertension. Mental-health screening also emerges as an important priority, not because the literature proves a uniform psychiatric effect for all shift workers, but because depressive symptoms and shift work disorder appear to identify a clinically meaningful vulnerable subgroup. Finally, several studied syntheses explicitly suggest schedule modification or prevention-oriented workplace policies, particularly regarding prolonged or intense night work (Wang et al., 2018; Sun et al., 2017; Torquati et al., 2019; Yang et al., 2022).

5. CONCLUSIONS AND IMPLICATIONS

This review supports the conclusion that shift work has meaningful adverse effects on selected health aspects, but the strength of the evidence differs across domains. The analysed literature most strongly supports associations with cardiovascular disease and metabolic disorders. Mental-health effects are also supported, especially for depressive symptoms and for workers with probable shift work disorder. Cancer remains the most controversial domain in epidemiological terms: the studied literature support concern and plausibility, but not a simple or uniform claim that all shift work materially increases all cancer risk (Vyas et al., 2012; Wang et al., 2018; Wang et al., 2014; Gan et al., 2015; Torquati et al., 2019; Travis et al., 2016; Rivera-Izquierdo et al., 2020).

The most coherent integrative message is that shift work should be conceptualized as a chronic biological and behavioral stressor. It disrupts the temporal alignment of sleep, endocrine rhythms, feeding, recovery, and social life; over time, those disruptions accumulate as cardiometabolic strain, psychological burden, and potentially carcinogenic processes. This model is especially compelling when the exposure is intense, prolonged, poorly matched to chronotype, or accompanied by insufficient sleep (Faraut et al., 2013; James et al., 2017; Kecklund & Axelsson, 2016; Yang et al., 2022).

From a medical and occupational-health standpoint, the reviewed literature points toward three practical implications. First, exposure assessment should be more granular, capturing not only "shift work" in general but also duration, intensity, rotation pattern, chronotype fit, and sleep duration. Second, preventive surveillance should prioritize cardiometabolic outcomes and depressive symptoms, especially in workers with long-term or high-intensity night schedules. Third, interventions should focus on schedule design, recovery protection, and early identification of workers who manifest shift work disorder or accelerating cardiometabolic burden (Wang et al., 2018; Sun et al., 2017; Torquati et al., 2019; Booker et al., 2019; Yang et al., 2022).

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Formal analysis: MG, KO

Investigation: MA, WK, MW

Resources: AJ, KG, JJ

Data curation: KO

Writing – original draft: MG, MA

Writing – review & editing: JK, KG, JJ

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