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Narrative Review

Impact of Shift Work on Heart Health: Do Shift-Working Healthcare Workers Have Higher Cardiovascular Risk Than Non-Shift Healthcare Workers? A Narrative Review

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Abstract

Background: Shift work is unavoidable in continuous healthcare delivery, but whether shift-working healthcare staff carry greater cardiovascular risk than their non-shift colleagues has not been synthesised endpoint by endpoint.

Objective: To examine, for each cardiovascular risk factor and each clinical cardiovascular complication in turn, whether healthcare workers on shift schedules differ from healthcare workers on day schedules, and to state the strength of evidence supporting each answer.

Findings: The answer differs by endpoint. Among complications, shift-working staff show higher ischaemic heart disease incidence when night exposure is sustained (permanent night versus permanent day work: hazard ratio [HR] 1.61, 95% CI 1.06–2.43), higher cerebrovascular disease incidence with frequent nights (HR 1.69, 95% CI 1.18–2.42) and higher cardiovascular mortality (HR 1.71, 95% CI 1.09–2.69), whereas atrial fibrillation shows no difference (HR 0.78, 95% CI 0.49–1.23; 281 cases). Among risk factors, differences are consistent for adiposity (high waist circumference odds ratio [OR] 1.27, 95% CI 1.07–1.51), largely absent for lipids, and not demonstrated for hypertension in the single healthcare comparison available (HR 0.96, 0.75–1.23 across 875 incident cases, precise enough to exclude a modest excess). Type 2 diabetes, occupying an intermediate position, shows the most reproducible difference (HR 1.59, 95% CI 1.02–2.43 for permanent night work; HR 1.05 rising to 1.58 across two decades). Cross-industry appraisal rates certainty low for ischaemic heart disease

and very low for hypertension and metabolic outcomes.

Conclusion: Shift-working healthcare staff do carry higher cardiovascular risk than non-shift colleagues, but selectively rather than globally, and the excess attaches to sustained night exposure rather than to shift work as a category. Occupational surveillance is best directed at type 2 diabetes and waist circumference; screening for hypertension on this basis is not supported.

Keywords:
shift work; night work; cardiovascular risk; healthcare workers; nurses; type 2 diabetes; circadian misalignment; occupational health

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1. Introduction

Hospitals do not close, and European survey data indicate that approximately 40% of healthcare employees work some form of shift schedule [1]. Within any hospital, two populations therefore coexist: staff whose hours align with the light–dark cycle, and staff whose hours do not. They share an employer, a workplace, a professional culture and broadly similar education. What differs is when they work.

That natural comparison is the subject of this review. Rather than asking whether shift work is harmful in general, we ask a narrower question: do healthcare workers on shift schedules show worse cardiovascular outcomes than healthcare workers on day schedules? The distinction matters practically, because occupational health services act on within-workforce differences, and methodologically, because comparing within one occupation removes much of the socioeconomic confounding affecting cross-industry research.

The biological rationale for expecting a difference is well established. Human physiology is organised around an endogenous circadian system coordinating hormone secretion, autonomic tone, glucose handling and vascular function across the day–night cycle [2]. Imposing misalignment experimentally on healthy volunteers produces adverse change within days, including a 3% rise in mean arterial pressure, a 17% fall in leptin, a 6% rise in glucose despite a 22% rise in insulin, and inversion of the cortisol rhythm [3].

Whether such perturbation accumulates into disease across a working career is contested. Pooled analyses of general working populations report associations with myocardial infarction (risk ratio [RR] 1.23, 95% CI 1.15–1.31) and ischaemic stroke (RR 1.05, 95% CI 1.01–1.09) [4], and a 17% excess risk of any cardiovascular event with a further 7.1% increment per five years of exposure beyond

the first five (95% CI 1.05–1.10) [5]. Yet when those syntheses are themselves appraised using AMSTAR-2 and GRADE, certainty is rated low at best and very low for most metabolic outcomes [6]. Two things are therefore true at once: the direction of association is reasonably consistent, and the methodological quality of the evidence is poor.

This review examines each endpoint separately: Section 3 modifiable risk factors, Section 4 type 2 diabetes as an intermediate outcome, Section 5 clinical complications. For each we set out what the healthcare-specific comparison shows, what supporting evidence adds, and how strong the evidence is. Risk factors and complications are deliberately not mixed.

2. Scope and Approach

This is a narrative review and makes no claim to systematic methodology: no protocol was registered, no independent risk-of-bias appraisal was undertaken, and retrieval was not exhaustive. Studies were identified through PubMed searches and reference tracking, so selection reflects the authors' judgement rather than a reproducible procedure.

Two conventions govern the sections that follow. First, evidence is labelled by comparator: studies contrasting shift-working with day-working staff within a single healthcare population answer the review question directly and are presented first for each endpoint, while those from other working populations, laboratory protocols or the general population appear as supporting evidence. Second, the GRADE ratings cited throughout derive from cross-industry syntheses [4], [6] and describe the general shift-work literature, not the healthcare-specific studies, for which no formal grading exists. All intervals reported are 95% confidence intervals.

3. Modifiable Cardiovascular Risk Factors

3.1 Adiposity and metabolic syndrome

The healthcare-specific comparison is consistent. Among 5,775 Taiwanese hospital workers followed for eight years, with exposure taken from register-based daily working time records and outcomes from mandated annual health examinations, night shift workers had higher odds of new-onset high waist circumference than day workers (OR 1.27, 1.07–1.51) and of new-onset metabolic syndrome (OR 1.36, 1.04–1.78) [7]. The cohort was 56.9% nurses, the remainder technicians, clerks and pharmacists. Both associations strengthened when baseline triglycerides, glucose, waist circumference and systolic blood pressure were entered into the models (OR 1.40, 1.06–1.85 and OR 1.44, 1.17–1.78), arguing against reverse causation. Metabolic syndrome is a composite endpoint incorporating glucose and blood pressure, both examined separately below; it is reported here because waist circumference is its dominant contributor in this cohort.

A second healthcare comparison points the same way but weakly. Among 2,059 Norwegian nurses, the number of night shifts worked in the preceding year was associated with body mass index as a continuous variable (β=0.055, $P<0.05$) and with obesity (OR 1.01, 1.00–1.01) [8]. The odds ratio is negligible in isolation, and the cross-sectional design precludes temporal sequence.

Supporting evidence and appraisal. Experimental misalignment reduces leptin by 17% within days, providing a plausible mechanism for altered appetite regulation [3]. Cross-industry pooling gives an odds ratio of 1.25 (1.11–1.41) for obesity and RR of 1.59 (1.00–2.54) for metabolic syndrome, both graded very low certainty on account of severe heterogeneity and, for metabolic syndrome, evidence of publication bias [6].

Answer. Shift-working healthcare staff do show greater adiposity and more incident metabolic syndrome than day-working colleagues. Two independent healthcare cohorts on different continents agree, one using objective rostering data and objective anthropometry. The very low formal certainty of the wider literature attaches to previous meta-analyses rather than to these cohorts.

3.2 Blood pressure and hypertension

This is the endpoint where the healthcare-specific evidence most clearly contradicts expectation. Approximately 28,000 nurses and nursing assistants in Region Stockholm were followed from 2013 to

2017, with exposure derived from administrative employee registers and hypertension ascertained from national registers, yielding 875 incident cases [9]. Compared with day work only, no exposure pattern was associated with risk: permanent night work HR 0.96 (0.75–1.23), day and afternoon schedules without nights HR 1.04 (0.88–1.22), mixed schedules including nights HR 0.99 (0.81–1.21), and more than 120 afternoon or night shifts per year HR 0.95 (0.75–1.19). Cumulative exposure showed the same, all four duration categories falling between HR 0.94 and HR 1.00 (widest interval 0.69–1.39).

With 875 cases and upper bounds clustered around 1.2, the data are incompatible with an excess above roughly 20%: a negative result with useful precision, and evidence of absence rather than absence of evidence.

One healthcare finding points the other way. Within night shift workers in the Taiwanese cohort, a greater number of night shifts was associated with high blood pressure (OR 1.15, 1.01–1.31), though not with metabolic syndrome overall [7]. Note that this is a gradient within night workers rather than a comparison of night against day workers, so it does not directly answer the review question.

Supporting evidence and appraisal. Experimental misalignment raises mean arterial pressure by approximately 3% within days [3], and in a controlled feeding trial blood pressure fell 6–8% ($P<0.01$) when intake was restricted to daytime hours during simulated night work [10]. Cross-industry pooling gives an odds ratio of 1.10 (1.00–1.20) for hypertension, graded very low certainty for severe heterogeneity [6].

Answer. Not demonstrated. In the only adequately powered comparison, shift-working healthcare staff show no more diagnosed hypertension than day-working colleagues. That rests on a single cohort, so this is best described as a well-powered null awaiting replication rather than established absence of effect. The conflict with experimental data is probably one of measurement: misalignment produces real short-term change in blood pressure as a continuous variable, which need not accumulate into a registered diagnosis over a career. The umbrella review excluded studies measuring blood pressure continuously [6], so the two literatures measure different things.

3.3 Blood lipids

The healthcare-specific comparison is largely null. Among female nurses, biomarker differences were estimated using quantile regression, so the values below are absolute differences in medians and the null value is zero rather than one; analytic samples ranged from 458 to 3,574 [11]. Nurses who had worked one to four night shifts in the preceding fortnight had median high-density lipoprotein cholesterol 4.4 mg/dL lower than those with no recent night shifts (95% CI 0.3, 7.5). Neither five or more recent shifts nor cumulative years of rotating night work showed the same association, and no difference was detected for total cholesterol, low-density lipoprotein cholesterol, triglycerides or fibrinogen.

Supporting evidence and appraisal. A mechanistic review reported raised triglycerides in shift workers in four of twelve studies examined, an inconsistency the authors themselves noted [12]. No cross-industry meta-analysis of blood lipids was included in the umbrella appraisal, which excluded reviews measuring biomarkers rather than diagnosed conditions [6], so no formal certainty rating exists for this endpoint.

Answer. No, with one qualification. The only difference detected concerns high-density lipoprotein cholesterol after recent night shifts, does not persist with greater recent exposure or with cumulative exposure, and is not accompanied by change in any other fraction. A dose-dependent effect would be expected to strengthen rather than disappear with more exposure, and it does not.

3.4 Inflammatory markers

In the same nursing cohort, median C-reactive protein was higher among nurses with a history of rotating night work than among those with none: by 0.1 mg/L at one to five years (95% CI 0.0, 0.2), 0.2 mg/L at six to nine years (95% CI 0.1, 0.4) and 0.2 mg/L at ten years or more (95% CI 0.0, 0.4) [11]. Three qualifications limit what this can bear. Two of the three estimates have a lower bound of exactly zero, so only the six-to-nine-year estimate is unambiguously distinguishable from no difference; the associations attenuated when postmenopausal women and statin users were

excluded; and blood was drawn at a single timepoint, making these cross-sectional comparisons. The authors characterised the evidence as suggestive.

Supporting evidence and appraisal. Experimental sleep deprivation increases circulating leukocytes, interleukins and C-reactive protein [12], establishing that the pathway exists. The prognostic stakes are not trivial: across ascending C-reactive protein quintiles in 27,939 healthy women, adjusted relative risks of a first cardiovascular event reached 2.3, exceeding the gradient across low-density lipoprotein quintiles (1.5) [13], so a population shift of 0.2 mg/L would be prognostically meaningful if genuine. No formal certainty rating exists for this endpoint.

Answer. Uncertain. The direction is consistent and the mechanism is plausible, but two of three estimates are statistically indistinguishable from no difference, and the finding rests on a single cross-sectional analysis in one occupational group.

3.5 Neuroendocrine and autonomic function

The one healthcare-specific comparison here is in physicians, a group otherwise almost absent from this literature. Seventy physicians of mean age thirty were followed for one year, with salivary cortisol sampled four times daily on two consecutive working days at baseline and follow-up [14]. After adjustment for baseline cortisol secretion and multiple covariates, shift work at baseline predicted a steeper diurnal cortisol slope ($P<0.01$), a larger total cortisol output measured as area under the curve ($P<0.05$), and higher waking cortisol ($P<0.01$) at one year, relative to day-working colleagues.

Supporting evidence and appraisal. More than fifteen field studies in shift workers generally report reduced parasympathetic modulation of heart rate variability or increased sympathetic activity, and prolongation of the rate-corrected QT interval has been described [12]. Under simulated night work, participants eating at night showed reduced cardiac vagal modulation (pNN50 fell 25.7%, pFDR=0.008; RMSSD fell 14.3%, pFDR=0.02) and a 23.9% rise in plasminogen activator inhibitor-1 (pFDR=0.04) [10]. Neither body of work is drawn from healthcare workers, and no formal certainty rating exists.

Answer. Yes for hypothalamic-pituitary-adrenal function, where shift-working physicians differ measurably from day-working physicians within a single year. For autonomic function the answer is unknown, because no study has compared shift and non-shift healthcare workers on heart rate variability or related measures.

4. Type 2 Diabetes: An Intermediate Outcome

Type 2 diabetes occupies a position between the risk factors above and the complications below: a diagnosed disease in its own right, and among the strongest modifiable determinants of ischaemic heart disease. It is treated separately for that reason, and because the healthcare-specific evidence is strongest here.

In the Stockholm healthcare workforce, follow-up from 2013 to 2017 identified 232 incident cases [9]. Compared with day work only, employees who worked only night shifts in the preceding year had increased risk (HR 1.59, 1.02–2.43), as did those working more than 120 afternoon or night shifts in the preceding year (HR 1.67, 1.11–2.48). Mixed day and afternoon schedules showed a non-significant tendency in the same direction (HR 1.34, 0.97–1.88), and employees working three or more consecutive night shifts fifteen to twenty times per year showed increased risk under a three-year exposure window (HR 1.71, 1.05–2.63), though not in the primary one-year-window analysis. Notably, more than 120 night shifts alone was not significant (HR 1.30, 0.86–1.89), so the signal attaches to overall unsocial-hours load rather than to night shifts counted in isolation.

A second and much larger healthcare comparison shows a duration gradient. Across 69,269 women in the first Nurses' Health Study and 107,915 in the second, with 10,126 incident cases accrued over eighteen to twenty years, pooled hazard ratios relative to nurses who never worked rotating nights rose monotonically with duration: HR 1.05 (1.00–1.11) at one to two years, HR 1.20 (1.14–1.26) at three to nine years, HR 1.40 (1.30–1.51) at ten to nineteen years and HR 1.58 (1.43–1.74) at twenty years or more ($P<0.001$ for trend) [15]. Further adjustment for updated body mass index reduced these to 1.03 (0.98–1.08), 1.06 (1.01–1.11), 1.10 (1.02–1.18) and 1.24 (1.13–1.37), with the trend

preserved (P<0.001). Because weight gain plausibly lies on the causal pathway rather than confounding it, the unadjusted estimates better express total effect, and the residual gradient indicates partial mediation through adiposity (Section 3.1).

The two cohorts agree on the categorical association and disagree on the gradient: in Stockholm no trend was detectable with increasing night shift number (HR 1.01, 0.97–1.06 per ten shifts) and cumulative years showed no association. These need not conflict, since the nursing estimates were themselves near-null below ten years while the Stockholm cohort held a mean of 6.0 years of exposure data and 3.7 years of follow-up — probably too short to observe the gradient, which currently rests on a single self-reported exposure dataset.

A third, weaker observation is consistent: among 312 Greek hospital workers, diabetes was the condition most commonly reported by shift workers compared with morning-shift colleagues (P=0.008) [16].

Supporting evidence and appraisal. Cross-industry pooling gives a risk ratio of 1.40 (1.18–1.66) for diabetes, graded very low certainty on account of extreme heterogeneity (I^2=95) [6]. Experimental misalignment raises glucose by 6% despite a 22% rise in insulin, and three of eight evaluable participants reached postprandial glucose in the prediabetic range within days [3].

Answer. Yes, and this is the most reproducible difference in the review. Two large prospective healthcare cohorts on different continents, one using self-reported and one using register-derived exposure, agree that sustained night work raises diabetes risk relative to day work. The very low cross-industry grading reflects the poor quality of previous meta-analyses rather than a defect in these cohorts. What is not established is the shape of the exposure–response relationship.

5. Cardiovascular Complications

5.1 Ischaemic heart disease

The most directly relevant study followed 30,398 healthcare employees — nurses including midwives, nursing assistants and related occupations — employed for at least one year in Region Stockholm between 2008 and 2016, accruing 211,144 person-years and 223 incident ischaemic heart disease cases during 2009–2016 [1]. Exposure was classified annually from daily working-hour records, with adjustment for sex, age, country of birth, education and profession. The comparator throughout is permanent day work within the same workforce.

Relative to permanent day workers, employees on permanent night shifts had higher risk (HR 1.61, 1.06–2.43), with an incidence of 22.9 against 12.1 per 10,000 person-years. Risk was similarly raised with more than 120 night shifts per year (HR 1.53, 1.05–2.21) and with three or more consecutive nights fifteen to twenty times yearly (HR 1.85, 1.14–2.98). Trend testing indicated a 3% increase per ten additional night shifts (HR 1.03, 1.00–1.05) and 6% per ten additional spells of consecutive nights (HR 1.06, 1.00–1.20); both lower bounds sit at unity, so these gradients are directionally informative but marginal.

Critically for the review question, not all shift workers differed from day workers. Mixed schedules that included night shifts carried no excess risk (HR 0.93, 0.58–1.49), nor did day-and-afternoon schedules without nights (HR 1.11, 0.79–1.55). Short inter-shift recovery emerged as a separate exposure: among employees who never worked nights, frequent quick returns of under eleven hours after afternoon shifts carried a 4% increment per ten additional returns (HR 1.04, 1.00–1.10). Long working weeks exceeding 45 hours carried no excess risk.

Supporting evidence and appraisal. Cross-industry pooling of 34 studies comprising 2,011,935 individuals gives a risk ratio of 1.23 (1.15–1.31) for myocardial infarction and 1.24 (1.10–1.39) for coronary events, with night shifts carrying the highest estimate of any schedule (RR 1.41, 1.13–1.76) [4]. A second synthesis estimated a 26% excess for coronary heart disease morbidity (pooled effect size 1.26, 1.10–1.43) and a non-linear exposure–response in which no significant excess was detectable during the first five years [5]. That effect size pools risk, odds and hazard ratios together, which is not statistically neutral where outcomes are common. Both syntheses used non-shift day workers as reference, so their comparator matches the question posed here. The two published ap-

praisals disagree: the first graded its own myocardial infarction estimate moderate and its coronary event estimate low [4], whereas the later umbrella appraisal rated ischaemic heart disease (RR 1.13, 1.08–1.20) and myocardial infarction (RR 1.27, 1.17–1.39) low, and cardiovascular disease broadly defined very low [6].

Answer. Yes, but only for a subset. Healthcare workers on permanent or high-frequency night schedules have higher ischaemic heart disease incidence than day-working colleagues; healthcare workers on mixed schedules that include occasional nights do not. Framing the question as "shift workers versus non-shift workers" is therefore too coarse: the meaningful exposure is sustained night work and short inter-shift recovery.

5.2 Cardiovascular mortality

The Danish Nurse Cohort provides the only healthcare-specific mortality comparison. Of 28,731 female nurses recruited in 1993 or 1999, 18,015 were analysed, and 1,616 died before follow-up ended in 2013, including 217 from cardiovascular disease [17]. Relative to day-working nurses, night work was associated with cardiovascular mortality (HR 1.71, 1.09–2.69). Both night work (HR 1.26, 1.05–1.51) and evening work (HR 1.29, 1.11–1.49) were associated with increased all-cause mortality, whereas cancer mortality (HR 1.05, 0.81–1.35) and psychiatric mortality (HR 1.17, 0.47–2.92) did not differ.

Supporting evidence and appraisal. The wider literature is divided. One pooled analysis found no association between shift work and mortality of any kind, despite clear associations with morbidity [4]; another reported excess cardiovascular (effect size 1.22, 1.09–1.37) and coronary (1.18, 1.06–1.32) mortality without heterogeneity [5]. Formal appraisal rates all-cause mortality very low certainty (RR 1.04, 0.97–1.11) [6].

Answer. Yes in the one healthcare cohort that has examined it, with an important caveat. Mortality is a late endpoint, and staff who cope badly with night duty leave night work long before heart disease appears, so such comparisons examine a group that has already lost its most vulnerable members. The attenuation is directly observable: in the Helsinki Heart Study the coronary relative risk among shift workers fell from 1.59 at five years to 1.34 at thirteen as the cohort approached retirement [12]. The true difference is more likely understated than overstated.

5.3 Atrial fibrillation

Atrial fibrillation has been examined once in a healthcare workforce. In a cohort of 30,475 Stockholm healthcare employees contributing 211,546 person-years, 281 incident cases were identified, and no exposure pattern differed from permanent day work: permanent night shifts HR 0.78 (0.49–1.23), mixed schedules including nights HR 0.90 (0.59–1.36), day-and-afternoon schedules HR 1.21 (0.91–1.60), with no trend detected for night shift frequency, quick returns or long working weeks [1]. A trend toward decreasing risk with more frequent long working weeks was attributed by the authors to a healthy worker effect rather than any protective mechanism.

Supporting evidence and appraisal. The mechanistic literature does not in fact predict an atrial effect. Prolongation of the rate-corrected QT interval concerns ventricular repolarisation rather than atrial conduction, and no mechanistic work specifically implicates atrial electrophysiology in shift workers [12]. No cross-industry meta-analysis of atrial fibrillation was included in the umbrella appraisal, so no formal certainty rating exists.

Answer. No. Across 281 cases and more than 211,000 person-years, shift-working healthcare staff show no excess of the commonest clinical arrhythmia. These data do not address ventricular arrhythmias, on which no outcome data in this population exist.

5.4 Cerebrovascular disease and stroke

The Stockholm cohort has been examined for cerebrovascular disease using the same register, design and covariates as the ischaemic heart disease analysis above [18]. Among 30,460 nurses and nursing assistants, physicians again excluded, 240,469 person-years yielded 223 incident cerebrovascular events during 2009–2017, of which 132 were strokes (115 ischaemic, 16 haemorrhagic).

Classified simply by type of schedule, no group differed significantly from permanent day workers: shift work including nights carried HR 1.46 (0.96–2.21) and night work only HR 1.39 (0.88–2.21). Risk emerged only when exposure was quantified. Relative to employees who never worked nights, excess risk attached to more than 30 night shifts in the preceding year (HR 1.44, 1.04–1.99), three or more consecutive nights more than 15 times (HR 1.69, 1.18–2.42), more than 30 quick returns of under 28 hours from nights (HR 1.52, 1.10–2.10), and more than five cumulative years of night work (HR 1.87, 1.27–2.77), each supported by a trend — most clearly an 8.3% risk increase per additional year of night work (HR for beta 1.083, 1.031–1.139). Quick returns from non-night shifts and long working weeks showed no association.

Analyses restricted to stroke were concordant, reaching significance for frequent consecutive nights (HR 1.60, 1.01–2.54) and for more than five years of night work (HR 2.04, 1.26–3.28). Adjusting consecutive nights and quick returns for total night-shift volume strengthened the estimates substantially, though with wide intervals (HR 5.54, 1.83–16.76 and HR 3.09, 1.26–7.56), suggesting these features act at least partly independently of night-shift volume.

This is the exposure signature that predicted ischaemic heart disease in Section 5.1: frequent nights, consecutive night runs and short recovery, with long working weeks exerting no effect. That two anatomically distinct vascular endpoints respond to the same schedule features in the same workforce is difficult to attribute to a single outcome-specific bias.

Supporting evidence and appraisal. Pooled data give a risk ratio of 1.05 (1.01–1.09, $I^2=0$) for ischaemic stroke, graded moderate certainty by those reviewers [4] and low by the later umbrella appraisal [6]. One caveat cuts in this review's favour: that estimate rests on only two studies totalling 80,787 participants, of whom 80,108 were nurses in a single prospective cohort, so the figure conventionally described as cross-industry is in practice almost entirely derived from healthcare workers.

Answer. Yes, for quantified night exposure rather than shift work as a category. Healthcare workers with frequent nights, frequent consecutive nights, short recovery or more than five years of night work show higher cerebrovascular disease and stroke incidence than colleagues who do not work nights; being classified as a night worker, without regard to intensity, does not by itself confer measurable excess risk.

6. Discussion

Taken endpoint by endpoint, and as Table 1 summarises, the answer is a qualified yes: shift-working healthcare staff do carry higher cardiovascular risk than non-shift colleagues, but selectively rather than globally. Where differences are absent — hypertension and atrial fibrillation — the estimates are precise enough that the null is informative rather than merely uninformative.

A pattern runs through the positive findings: wherever exposure was characterised in detail, the excess attached to sustained night work rather than to shift work as a category. Mixed schedules including occasional night duty carried no excess ischaemic risk [1]; cerebrovascular risk emerged only once night exposure was quantified [18]; diabetes risk attached to permanent night work and high unsocial-hours load, not to night shift count alone [9]; and the wider literature describes no excess detectable in the first five years [5]. A nurse working occasional nights within a rotating roster is not, on present evidence, at measurably higher cardiovascular risk than a day-working colleague. A nurse on a permanent night contract, working upwards of ten nights a month, or repeatedly running three or more nights together, probably is.

That distinction has practical consequences, because the exposures carrying risk are ones employers already control: permanent night assignment, annual night counts, consecutive night runs and inter-shift recovery. None has been tested as an intervention, but each is more actionable than a general recommendation to reduce shift work [1], [18]. A controlled trial suggests a second, non-rostering lever: during simulated night work, daytime-restricted eating preserved cardiac vagal modulation, prothrombotic markers and blood pressure, while eating at night did not, despite identical mistimed sleep [10]. With twenty volunteers over two weeks this is proof of principle rather than demonstrated benefit, but food timing is modifiable and requires no roster change.

Three features constrain these conclusions. The first is that research effort inverts the distribution of exposure. Nurses are comparatively well studied, though chiefly for mortality rather than incidence. Physicians appear only in the cortisol comparison [14] and are excluded by design from the largest register-based cohorts, their hours being recorded in less detail [1]. Healthcare assistants are adjusted for as a covariate in the Stockholm cohorts but never analysed separately, despite forming the largest share of permanent night workers and despite 66% of those workers having upper secondary education or less against 43% of day workers [1]. The most heavily exposed group is therefore the least separately described.

Table 1. Summary of findings by endpoint

Endpoint	Healthcare-specific comparison (shift vs non-shift staff)	Direction	Cross-industry GRADE	Answer to the review question
RISK FACTORS				
Adiposity and metabolic syndrome	Waist circumference OR 1.27 (1.07–1.51); metabolic syndrome OR 1.36 (1.04–1.78) [7]; BMI β=0.055, P<0.05 [8]	Higher in shift staff	Very low (obesity; metabolic syndrome)	Yes — consistent across cohorts
Blood pressure and hypertension	Incident hypertension HR 0.96 (0.75–1.23), 875 cases [9]; within night workers, more nights → high BP OR 1.15 (1.01–1.31) [7]	No difference	Very low	Not demonstrated — well-powered null, single cohort
Lipids	HDL 4.4 mg/dL lower (95% CI 0.3, 7.5) with recent nights; total cholesterol, LDL, triglycerides all null [11]	Largely no difference	Not graded	Largely absent — isolated HDL signal only
Inflammatory markers	C-reactive protein higher by 0.1–0.2 mg/L with cumulative night work; two of three estimates touch the null [11]	Possibly higher	Not graded	Uncertain — marginal estimates
Neuroendocrine and autonomic function	Steeper diurnal cortisol slope (P<0.01), larger AUC (P<0.05), higher waking cortisol (P<0.01) in physicians [14]	Higher in shift staff	Not graded	Yes for cortisol; no autonomic data

Table 1 (continued)

Endpoint	Healthcare-specific comparison (shift vs non-shift staff)	Direction	Cross-industry GRADE	Answer to the review question
RISK FACTORS				
INTERMEDIATE OUTCOME				
Type 2 diabetes	Permanent night HR 1.59 (1.02–2.43); >120 afternoon/night shifts HR 1.67 (1.11–2.48) [9]; duration 1.05→1.58 over 20 years [15]	Higher in shift staff	Very low	Yes — most reproducible finding
COMPLICATIONS				
Ischaemic heart disease	Permanent night vs permanent day HR 1.61 (1.06–2.43); mixed schedules with nights HR 0.93 (0.58–1.49) [1]	Higher with sustained nights only	Low	Yes — but exposure-specific
Cardiovascular mortality	Night work HR 1.71 (1.09–2.69) vs day-working nurses [17]	Higher in shift staff	Very low (all-cause)	Yes — with selection caveats
Atrial fibrillation	Permanent night HR 0.78 (0.49–1.23), 281 cases; no trend for any exposure [1]	No difference	Not graded	No
Cerebrovascular disease and stroke	>30 nights/year HR 1.44 (1.04–1.99); ≥3 consecutive nights >15 times HR 1.69 (1.18–2.42); >30 quick returns HR 1.52 (1.10–2.10); >5 years night work HR 1.87 (1.27–2.77); stroke alone HR 2.04 (1.26–3.28) [18]	Higher with quantified night exposure	Moderate (stroke) per [4]; low per [6]	Yes — same exposure pattern as IHD

Notes: HR, hazard ratio; OR, odds ratio; RR, risk ratio. GRADE certainty ratings derive from an umbrella review of cross-industry syntheses [6] and do not describe the healthcare-specific studies.

The second is statistical. Event counts are modest — 223 ischaemic, 223 cerebrovascular, 281 atrial fibrillation, 232 diabetes — limiting power for subgroup analysis and explaining why none reports profession-stratified results. Several intervals above have lower bounds at or close to unity. The two Stockholm analyses draw on overlapping populations, so they corroborate each other on exposure

measurement but do not constitute independent replication, and their follow-up is short relative to the latency of the outcomes concerned.

The third is the healthy worker survivor effect, which acts throughout to attenuate rather than inflate observed differences. Staff who tolerate night work poorly move to day work or leave the profession, so those remaining in long-term night rotations are a selected and relatively resilient group. The Stockholm investigators note that because Swedish employers must offer medical checks to night workers, this effect probably outweighs any selection of higher-risk staff into night work, so their estimates may understate the true risk [1], [18]. Where this review reports a difference, the true difference is likely larger; where it reports a null, the null is correspondingly harder to explain away.

Finally, the formal quality of the wider evidence is poor. On AMSTAR-2 appraisal the cross-industry syntheses fulfilled on average only seven of sixteen quality items; few had a registered protocol and nearly all failed to conduct a comprehensive search [6]. Certainty was graded low for ischaemic heart disease and very low for cardiovascular disease broadly defined, hypertension and every metabolic outcome. These ratings describe the general literature rather than the healthcare-specific cohorts on which this review principally relies, and in our reading they penalise previous pooling rather than those cohorts.

7. Conclusion

Shift-working healthcare staff carry higher cardiovascular risk than their non-shift colleagues for some endpoints and not others, and the pattern is consistent enough to guide practice. Ischaemic heart disease, cerebrovascular disease, cardiovascular mortality, type 2 diabetes and adiposity all show differences favouring day work; hypertension and atrial fibrillation show none, with intervals precise enough to exclude a modest excess; and lipids and inflammatory markers remain unresolved.

The excess attaches to sustained night exposure rather than to shift work in general. Occupational health surveillance in healthcare is therefore best targeted at staff on permanent night contracts, high annual night counts or frequent consecutive nights, and best directed at type 2 diabetes and waist circumference, the endpoints with the most consistent supporting evidence. Screening for hypertension on the basis of shift work alone is not supported by the data reviewed here.

Much of what would strengthen this evidence base requires no new data collection: the Nordic cohorts already holding register-derived exposure and registry outcomes could report results stratified by professional category, and physician rostering data could be linked the same way. Until then, shift work is most accurately described to healthcare workers as a probable contributor to ischaemic and metabolic risk at high cumulative night exposure, with weight and glucose the aspects most worth monitoring, and blood pressure and cardiac rhythm reassuringly unaffected on current evidence.

Competing Interests

The authors have declared that no competing interests exist.

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