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Caffeine, Alcohol, and Tobacco Use in Shift-Working Healthcare Professionals: A Systematic Review

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Abstract

Background: *Shift work is a central feature of modern healthcare systems, particularly in hospital and emergency settings. However, irregular schedules are associated with circadian disruption and sleep loss, which may lead to increased use of substances such as caffeine, alcohol, tobacco, and sleep aids among healthcare professionals. Understanding this association is essential for workforce well-being and patient safety. This systematic review examines the relationship between night or rotating shift work and substance use among physicians and nurses with attention to potential sleep disruption.*

Methods: *Following PRISMA guidelines, we searched PubMed, Embase, Web of Science, PsycINFO, and CENTRAL. We included observational studies involving healthcare professionals exposed to night or rotating shifts and assessing substance use outcomes. Data were extracted on study design, population, exposure definitions, substances used, sleep factors, and risk of bias.*

Results: *Ten observational studies (8 cross-sectional, 1 cohort, 1 case-control; n = 327–3,917) were included. Caffeine was the most consistently associated substance, with seven to ten studies reporting higher intake among shift workers—up to 67% of surgeons and a significant increase among night-shift nurses. Alcohol and tobacco showed mixed associations: two studies found significantly higher use among shift workers, while others reported no difference after adjustment. Sleep aid and sedative use was elevated in several studies but rarely reached statistical significance. One Ethiopian study identified higher khat use among nurses with shift work sleep disorder, though significance was lost after adjustment. No study analyzed dose-response by shift intensity or duration. Overall, risk of bias was moderate and interpretation of these findings was limited by the predominance of cross-sectional designs, methodological heterogeneity, and reliance on self-reported measures.*

Conclusion: *Caffeine consumption was a pervasive coping strategy among shift-working healthcare professionals, whereas associations with alcohol, tobacco, and sleep aids were inconsistent. Given the implications for fatigue, performance, and patient safety, institutional interventions, such as fair scheduling policies and preventive education on substance use, should be prioritized. Future longitudinal research is needed to clarify causal relationships and inform occupational health strategies.*

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Introduction

Healthcare systems around the world depend heavily on shift work to provide continuous patient care, particularly in hospital and emergency settings. Globally, over 20% of healthcare workers engage in night or rotating shifts to meet these demands (ILO, 2019). An expanding body of evidence links shift work to behavioral changes, including increased use of alcohol, caffeine, tobacco, and non-medical prescription drugs (Wang et al., 2011; Costa, 2010). These behaviors are often adopted as coping mechanisms in response to fatigue, circadian rhythm disruption, and psychosocial stress (Caruso, 2014).

Although interest in the relationship between shift work and substance use has increased, the evidence remains inconsistent, particularly among healthcare professionals. Previous studies have been limited by small sample sizes, vague definitions of shift work, and inadequate measurement of sleep quality (Papantoniou, 2023). These limitations hinder the validity and generalizability of the findings. While much of the literature has emphasized the physiological, psychological, or long-term health outcomes such as metabolic or oncologic risks (Silva, 2023), fewer studies have explored whether shift-induced sleep disturbances contribute to maladaptive behaviors such as substance use. Nevertheless, growing evidence supports a neurobiological link between sleep disruption and the brain's reward systems, providing a plausible mechanism for increased vulnerability to substance use in shift workers (Hasler et al., 2012; Guo et al., 2022; Fipps & Sinha, 2023).

This systematic review aims to assess the association between shift work and substance use among healthcare professionals, with particular emphasis on sleep disruption as a potential mediating factor. By prioritizing studies that use validated assessment tools and report both sleep and substance use outcomes, this review seeks to address key limitations in the existing literature.

Materials and Methods

Search strategy

Following the PRISMA 2020 guidelines, this literature review was carried out through a systematic search in five electronic databases: PubMed, Embase, Web of Science, PsycINFO, and CENTRAL. The objective of the search was to identify peer-reviewed observational studies examining the relationship between night or rotating shift work among healthcare professionals—specifically physicians, nurses, and midwives—and the use or misuse of substances.

Searches were performed between May 1st and May 5th, 2025, using a combination of free-text terms and controlled vocabulary (e.g., MeSH terms) for four concept groups: healthcare personnel; shift work (night, rotating); sleep disturbances (sleep deprivation, insomnia), and substances (alcohol, caffeine, tobacco/nicotine, energy drinks, prescription stimulants). Although the conceptual framework remained consistent across platforms, the search syntax was adapted to align with the technical requirements of each database. The search was limited to English-language publications due to feasibility and quality-control constraints (related to the lack of translation resources). No date restrictions were applied, and only peer-reviewed studies were considered for inclusion. Reference lists of included studies were not manually searched for additional citations. The full search strategies for each database are provided in Supplementary Material 1.

A PROSPERO submission for this systematic review was made on May 21, 2025, and the registration was approved on June 26, 2025, under the number CRD420251057617.

Inclusion and exclusion criteria

To ensure the relevance and methodological quality of the studies included, predefined inclusion and exclusion criteria were applied. Studies were eligible for inclusion if they met the following criteria: (1) Participants were physicians, nurses, or midwives aged 18 years or older; (2) Exposure involved night shift work, primarily defined as more than three night shifts per month, or related sleep factors such as sleep deprivation, insufficient sleep, circadian rhythm disruption, poor sleep quality, or poor sleep hygiene; (3) Outcomes assessed included substance use or substance-related disorders involving caffeine, alcohol, prescription stimulants (e.g., Adderall, Ritalin), or energy drinks; (4) The study design was observational in nature (e.g., cross-sectional, cohort, or case-control); and (5) Studies were published in English. Studies were limited to healthcare professionals as the primary study population; cohorts in which healthcare-worker data could not be isolated from mixed-occupation samples were excluded.

Studies were excluded if they met the following criteria: (1) Included pregnant women; (2) Included participants with pre-existing sleep disorders, such as sleep apnea or pre-existing drug use disorders; (3) Assessed individuals working day shifts only; (4) Did not report on substance use or misuse outcomes; (5) Focused primarily on opioid or cocaine use; and (6) Used a quasi-experimental design, or were

case reports, editorials, narrative reviews, posters, commentaries, or conference abstracts.

Selection of studies and data extraction

Study selection was conducted using Covidence software, whereby all retrieved records were initially screened by two independent reviewers who assessed the titles and abstracts against predefined eligibility criteria, followed by full-text screening, which was likewise performed independently by the same two reviewers. A formal inter-rater reliability statistic was not calculated; discrepancies at each stage were resolved through discussion, with unresolved cases adjudicated by a third reviewer.

Data extraction was conducted using Covidence, following the development and piloting of a standardized template. Two independent reviewers extracted the data. Any discrepancies were first discussed to reach consensus; unresolved disagreements were adjudicated by a third reviewer.

The following data were extracted from each included study: Study characteristics such as authorship, year, country, and study design; population details including sample size and participant type; exposure measures such as night shift frequency and sleep-related variables; outcomes assessed, including type of substance used (caffeine, alcohol, prescription stimulants, and energy drinks); assessment tools and relevant methodological features; and risk of bias assessment based on predefined criteria.

Data synthesis

Ten observational studies were included in this systematic review (Table 1), and their findings were synthesized to assess the relationship between shift work and substance use among healthcare professionals. Findings were organized by substance category (caffeine, tobacco/nicotine, alcohol, prescription stimulants/energy drinks) and, where feasible, by professional groups (physicians, nurses, midwives). When reported, effect estimates with 95% confidence intervals (e.g. odds ratios, risk ratios, prevalence ratios) were extracted and presented in Table 1.

Risk of bias assessment

Quality assessment was independently conducted by two reviewers using the Newcastle–Ottawa Scale (NOS), with adaptations based on study design (cohort, cross-sectional, and case-control). In cross-sectional studies, the maximum scores were 2 for Selection, 4 for Exposure/Outcome, and 3 for Comparability. Modified criteria were applied in case-control and cohort studies, allowing a maximum of 4 for Selection and 2 for Exposure/Outcome.

All assessments were conducted within Covidence, and any discrepancies were resolved through discussion, leading to a consensus on the quality of each study; unresolved disagreements were adjudicated by a third reviewer. The NOS scoring system ranged from 0 to 9: studies scoring $\geq$7 points were classified as "low risk of bias/ good quality"; scores between 4 and 6 indicated "moderate risk of bias/fair quality"; and scores $\leq$3 denoted "high risk of bias/poor quality".

Use of Artificial Intelligence Tools

To ensure clarity, organization and readability, generative artificial intelligence (AI) technology, specifically OpenAI's ChatGPT-4o model, was used during the manuscript drafting process. The tool assisted in structuring language, refining phrasing, and improving the overall coherence of the text. AI was used as a complementary tool and did not replace the authors' intellectual contributions, critical review, or scientific analysis.

Results

Description of the studies

A total of 835 articles were identified through systematic database searches using predefined keywords. After removing 165 duplicates (162 via Covidence and 3 manually), 670 unique records remained for title and abstract screening. Of these, 509 were excluded for not meeting the inclusion criteria or lacking relevance. The remaining 161 full-text articles were assessed for eligibility, with 151 subsequently excluded for reasons including wrong outcome (n = 36), non-eligible population (n = 26), abstract-only or conference posters (n = 23), wrong comparator (n = 22), inappropriate study design (n = 16), and other issues such as language restrictions or missing full texts. In total, ten studies met all criteria and were included in the final analysis.

Of the ten included studies, eight used a cross-sectional design, one was a case-control study, and one employed a cohort design, providing a broader temporal perspective on the effects of shift work. Sample sizes ranged from 327 to 951 participants, encompassing healthcare professionals, specifically nurses and physicians.

The years of publication ranged from 1992 to 2024, reflecting both early foundational research and more recent explorations. The studies spanned multiple countries and regions, including USA, Ethiopia,

Germany, Italy, and India, ensuring a diverse geographic and socioeconomic representation.

Shift work was generally defined as employment involving rotating-shifts, night-shifts, or schedules outside of standard daytime hours. In most cases, shift work was measured using self-reported schedules, though one study used standardized items from the National Center for Health Statistics (Gold et al., 1992). Exposure definitions varied: some studies required a minimum duration (e.g., one year), while others examined current employment status or shifts frequencies (e.g., rotating shifts). A comparative table that summarizes how each study defined shift work is provided in supplementary materials.

Population

Across the ten studies, nurses were the most commonly represented professional group (Gold et al., 1992; Haile et al., 2019; Vitale et al., 2023), followed by physicians, including surgeons and anesthesiologists (Franke et al. 2015). One study by Kamble et al. (2024) included a mixed population of nurses and physicians, allowing for comparisons across professional roles.

Participant ages varied across studies, ranging from the early 20s to mid-40s. The mean age was lowest in Haile et al. (2019) at 27.5 years ($\pm$5.6), while Franke et al. (2015) reported the highest mean of 42.01 ($\pm$10.36) years. Kamble et al. (2024) provided an age range of 21 to 45 years, stratified by subgroup. Female representation was generally high, reflecting the nursing population, with Gold et al. (1992) reporting 100% female participants, Vitale et al. (2023) reporting 76%, and Haile et al. (2019) reporting 54%. In contrast, only 30% of participants in Franke et al. (2015) were women.

Educational level and marital status were not consistently reported as standalone variables but were included as adjustment covariates in several studies. For example, Franke et al. (2015) adjusted for marital status and living with children, while Kamble et al. (2024) accounted for demographic and body composition variables. Haile et al. (2019) included adjustments for chronic illness and mental health, implying a broader assessment of participant background.

Sleep-related issues such as fatigue, poor sleep quality, and daytime sleepiness were frequently reported. These factors were often included either as exposures of interest or as covariates. Gold et al. (1992) specifically noted poor sleep quality and stimulant use among rotating-shift nurses, while Haile et al. (2019) found high prevalence rates of insomnia (48.1%) and excessive daytime sleepiness (25.5%). Sleep quality was formally assessed using validated instruments in some studies, such as the Pittsburgh Sleep Quality Index (PSQI) in Kamble et al. (2024).

Substance use was primarily assessed via self-report using tools such as Alcohol Use Disorders Identification Test – Consumption (AUDIT-C), Alcohol, Smoking and Substance Involvement Screening Test (ASSIST), or structured questionnaires, with variability in how substance use frequency and dependency were measured. Franke et al. (2015) described use of caffeine and other stimulants for cognitive enhancement among physicians. Vitale et al. (2023) explored the frequency of stimulant use, including caffeine and alcohol. Haile et al. (2019) provided data on khat and alcohol use, and Kamble et al. (2024) applied a modified ASSIST screening tool to assess substance use patterns. These variations in measurement tools highlight the methodological heterogeneity but also underscore a shared interest in how shift work may influence or correlate with substance use among healthcare professionals.

While the populations differed in age, profession, and geography, common threads across the studies included a predominance of female participants, frequent reports of poor sleep quality or fatigue, and a reliance on self-reporting to assess both sleep and substance use behaviors (Table 2).

Intervention characteristics and Effects/Exposure/Control

Exposure to shift work was categorized into three broad types: night-shifts, rotating-shifts, and extended/irregular-shifts. Most studies relied on self-reported shift schedules, though some used structured questionnaires or validated diagnostic tools.

Control groups, when present, consisted of individuals working fixed daytime schedules and were used as the reference population to evaluate the effects of shift-related disruptions. To provide greater clarity and comparability, the studies are grouped below based on the type of shift work exposure they assessed.

(1) Night-shifts were defined as work conducted during standard nighttime hours (8 PM to 6 AM). In Ethiopia, Haile et al. (2019) evaluated night and rotating-shift exposure using the third edition of International Classification of Sleep Disorders (ICSD-3) diagnostic criteria for shift work disorder, supported by validated scales such as the Bergen Insomnia Scale (BIS) and the Epworth Sleepiness

Author (Year)	Country	Study Design	Sample Size (N)	Shift Work Definition	Substance Use Outcome	Key Measures (OR, 95% CI)	Main Findings
Kamble et al., 2024	India	Case-control	327	Rotating-shifts (≥3 years)	Alcohol (AUDIT-C)	OR = 6.5 (sleep quality)	Shift workers had poorer sleep quality but no significant alcohol differences.
Swanson et al., 2023	United States	Cross-sectional	750	Night/rotating-shifts	Binge drinking (AUDIT)	OR = 2.08 (NS)	Binge drinking prevalence was 5.1%.
Vitale et al., 2023	Italy	Cross-sectional	406	Self-reported night shifts	Caffeine, energy drinks	PR = 1.16 (NS)	58% of nurses used stimulants; no significant association with shift work.
Buchvold et al., 2019	Norway	Prospective cohort	1,371	Night- shifts	Alcohol, caffeine, smoking	OR = 1.32 (alcohol, NS)	Night workers had higher caffeine use but no significant alcohol/smoking differences.
Haile et al., 2019	Ethiopia	Cross-sectional	399	Night/rotating-shifts	Khat, caffeine, alcohol	AOR = 1.8 (khat use, NS)	25.6% had shift work sleep disorder (SWSD); khat use associated with SWSD.
Franke et al., 2015	Germany	Cross-sectional	951	Night- shifts	Caffeine (coffee, tablets)	OR = 0.97 (age and caffeine use)	32% used caffeine for night shifts; prevalence higher in younger surgeons.
Flo et al., 2012	Norway	Cross-sectional	1,968	Permanent night/rotating-shifts	Melatonin, sleep medication	OR = 3.18 (melatonin, NS)	20.8% used sleep aids; association with night shifts not significant.
Gamble et al., 2011	United States	Cross-sectional	388	Night- shifts (12-hour)	Alcohol, caffeine	PR (not specified)	Genetic and phenotypic traits influenced substance use adaptation.
Trinkoff & Storr, 1998	United States	Cross-sectional	3,917	Adverse schedules (nights, extended shifts)	Alcohol, smoking	OR = 1.59 (smoking, $p < 0.01$)	Extended shifts + night work increased smoking/alcohol use.
Gold et al., 1992	United States	Cross-sectional	635	Rotating/night-shifts (>3 nights/month)	Sleep aids, alcohol	OR = 2.5 (near-miss accidents)	Rotating shifts are linked to higher sleep-related errors and alcohol use.

Table 1: *Characteristics of the included studies.*

Study ID	Age	% Female	Occupation	Factors Considered	Type of Questionnaire Used	Sleep Issues/ Fatigue
Kamble 2024	21–45 years (varies)	Not specified	Nurses & Physicians	Demographics & body composition	Assessed with substance use screening questionnaire	PSQI used to assess sleep quality
Vitale 2023	39.9 (SD 11.6)	76%	Nurses	Not adjusted	Frequency of stimulant use (caffeine, alcohol)	Fatigue, poor sleep quality, stimulant use
Swanson 2023	Not reported	Not reported	Not reported	Not reported	Binge drinking prevalence (AUDIT)	Not reported
Haile 2019	27.5 ± 5.6 years	54%	Nurses	Age, Sex, Chronic Illness, Mental Health	Self-reported use of khat, alcohol, etc.	Insomnia, excessive daytime sleepiness
Franke 2015	42.01 ± 10.36 years	30%	Physicians	Age, Sex, Marital Status, Children	Use of caffeine for cognitive enhancement	Fatigue, sleep deprivation, long shifts
Gold 1992	Mean = 33.9 years	100%	Nurses	Age, Work Tenure	Self-reported issues due to sleepiness	Sleep deprivation, poor sleep quality

Table 2: *Demographic characteristics of study populations.*

Scale (ESS). This study did not include a day-shift control group. In contrast, Buchvold et al. (2019), using data from the Norwegian Survey of Shift work, Sleep, and Health cohort (SUSSH), classified exposure based on annual self-reports and compared consistent night shift workers to consistent day workers. Swanson et al. (2023) utilized the Munich Chronotype Questionnaire (MCTQ-Shift) to distinguish between night/rotating and day shifts, with standard daytime workers serving as controls. Similarly, Vitale et al. (2023) explored stimulant use among Italian nurses with self-reported exposure to occasional night-work. Though no formal control group was used, comparisons were made across different levels of exposure.

(2) Rotating-shifts involved alternating work schedules, including day, evening, and night shifts. Kamble et al. (2024), conducting a study in India, defined exposure as rotating schedules involving at least three-night shifts per month over a three-year period. Shift histories were collected through structured interviews, and the control group consisted of staff working fixed daytime shifts. In a study by Czeisler et al. (1992), nurses working more than three-night shifts per month were considered exposed, while the control group worked only day or evening shifts. Validated tools were used to assess related outcomes, including sleepiness. Trinkoff & Storr (1998) also included both night and rotating shifts under the category of "adverse" schedules. Their control group comprised nurses with exclusively daytime shifts, based on data from a national survey.

(3) Extended or irregular shifts included longer-than-standard work hours or frequent overnight responsibilities. Franke et al. (2015) investigated this type of exposure among hospital-based surgeons, using detailed questionnaires to assess workload and shift frequency. Instead of a separate control group, comparisons were made within the sample based on the frequency of shift work and behaviors such as caffeine use. Gamble et al. (2011) focused on nurses working 12-hour night shifts within a rotating 3-on/2–5-off pattern. Exposure was assessed using standardized sleep behavior questionnaires and genotyping. Control participants in this study were nurses working regular day shifts.

(4) Daytime shifts involved those participants working typically between 8 am to 5 pm. These groups served as the reference to evaluate the impact of shift work on outcomes such as fatigue, sleep disturbances, lifestyle habits, and cognitive performance. However, three studies (Haile et al., 2019; Franke et al., 2015 and Vitale et al., 2023) did not include distinct day-shift control groups, relying instead on internal comparisons within the exposed populations.

Outcomes

This review included ten observational studies examining substance use outcomes among healthcare workers engaged in shift or night work. The primary substances assessed across studies were alcohol, tobacco, caffeine, sleep aids, stimulants (including prescription stimulants), cannabis, opioids, sedatives, and, in one setting, the region-specific stimulant khat.

All outcomes were self-reported, using structured surveys or standardized screening tools without biological confirmation. Measurement approaches varied, ranging from simple yes/no questions to detailed frequency scales and validated instruments such as the AUDIT-C and ASSIST.

For example, Kamble et al. (2024) used the ASSIST questionnaire to capture use and severity across multiple substance categories, also assessing sleep quality with the PSQI. Swanson et al. (2023) and Flo et al. (2012) focused specifically on alcohol, using the AUDIT-C to identify risky drinking patterns. Vitale et al. (2023) assessed weekly frequency of caffeine, alcohol, tobacco, and sleep aid use, including subjective reliance questions (e.g., "I need caffeine to stay alert during shifts"). Trinkoff & Storr (1998) measured frequency of alcohol, tobacco (cigarettes/day), and caffeine use, reporting odds ratios for heavy smoking.

Other studies used simpler or dichotomous approaches: Buchvold et al. (2019) and Gold et al. (1992) asked yes/no questions about smoking or drinking status. Haile et al. (2019) assessed khat use with frequency categories (daily, weekly, monthly). Franke et al. (2015) measured alcohol in units per week via self-report, while Gamble et al. (2011) explored stimulant use to maintain alertness, collecting frequency and motivation data.

Main results

Across the included studies, there was a consistent pattern indicating that exposure to night or rotating shifts was associated with increased substance use, most consistently for caffeine. However, the strength and consistency of associations for alcohol and tobacco/nicotine were variable, and evidence on other substances was limited.

Caffeine

Caffeine use was the most frequently assessed and consistently associated substance: seven out of ten studies examined caffeine consumption, with most reporting higher usage among shift workers. Across studies, higher caffeine consumption was observed among night/rotating staff (∼55–70%; Table 1); in Franke et al. (2015), about one-third of surgeons attributed their use specifically to night shifts. A statistically significant inverse association between age and caffeine use was observed (OR = 0.972; 95% CI: 0.955–0.989; $p = 0.002$), indicating higher caffeine use in younger professionals. Buchvold et al. (2019) found similar daily consumption between night and day workers (69% in both groups), with an adjusted OR of 1.01 (95% CI: 0.71–1.42), suggesting no significant difference. Across studies, caffeine showed the strongest and most consistent association with shift work exposure.

Alcohol

Alcohol use was assessed in five studies with mixed results. Buchvold et al. (2019) observed higher AUDIT-C scores among night workers, but no significant association above threshold levels (OR = 1.32; 95% CI: 0.73–2.41; $p = 1.00$). These findings indicate a moderate and inconsistent association between shift work and alcohol use, with significance often lost after adjustment.

Tobacco

Tobacco use showed variable results. Trinkoff & Storr (1998) found a significant association between shift work and smoking more than 10 cigarettes per day (OR = 1.59; $p < 0.01$). Conversely, Buchvold et al. (2019) found no significant difference in daily smoking rates between night and day workers (OR = 0.86; 95% CI: 0.50–1.51), despite observing a statistically significant difference in smoking prevalence ($p = 0.003$). These discrepancies may reflect population differences or uncontrolled confounding.

Other substances

Sleep aids and sedatives, including melatonin and prescription/non-prescription sleep medications, were evaluated in four studies. Flo et al. (2012) reported greater melatonin use among shift workers (OR = 3.18; 95% CI: 0.92–10.98), though this did not achieve statistical significance. One study assessed a culturally specific substance, *khat*, in Ethiopia (Haile et al., 2019). Khat use was more common among nurses with SWSD (32/102) compared to those without (49/297). The crude OR was significant (COR = 2.31; 95% CI: 1.378–3.886; $p < 0.05$), but this association was no longer statistically significant after adjustment (AOR = 1.8; 95% CI: 0.783–3.955; $p > 0.05$).

Study ID	Substances Assessed	Measurement Approach	Instruments
Kamble et al., 2024	Alcohol, tobacco, cannabis, sedatives, stimulants, opioids	Frequency categories; severity screening	ASSIST questionnaire; also, PSQI for sleep quality
Swanson et al., 2023	Alcohol	Risk drinking threshold	AUDIT-C
Vitale et al., 2023	Caffeine, alcohol, tobacco, sleep aids	Weekly frequency; subjective reliance	Self-report survey with motivation questions
Buchvold et al., 2019	Smoking (cigarettes, snuff)	Yes/No use	Dichotomous questions
Haile et al., 2019	Khat	Frequency categories (daily/weekly/monthly)	Structured questionnaire
Franke et al., 2015	Alcohol	Units per week	Self-report
Flo et al., 2012	Alcohol	Risk drinking threshold	AUDIT-C
Gamble et al., 2011	Stimulants (caffeine, prescription stimulants)	Frequency; reasons for use	Self-report; focused on motivation to stay alert
Trinkoff & Storr, 1998	Alcohol, tobacco, caffeine	Frequency/week; cigarettes/day; heavy use ORs	Structured survey
Gold et al., 1992	Alcohol, caffeine, tobacco	Yes/No use	Dichotomous questions

Table 3: *Substance use outcomes and measurement approaches in included studies.*

No studies explicitly analyzed dose-response relationships between shift work intensity (e.g., number of night shifts per month) or duration (years of exposure) and substance use. However, some studies required a minimum of 1–3 years of shift work (e.g., Kamble 2024), and Buchvold et al. (2019) included a 6-year follow-up, suggesting possible cumulative exposure effects.

Assessment of risk of bias in individual studies

Risk of bias was assessed using the NOS. Most studies were classified as moderate quality, two were good quality and none was poor quality (Table 3). Sample selection was predominantly representative, but often lacked clear justification, particularly among the cross-sectional studies, which had a possible maximum score of two in that category. Only one cohort (Buchvold et al., 2019) and one case-control (Kamble et al., 2024) were eligible for the maximum of four points in the selection domain. However, Buchvold et al. (2019) failed due to reliance on self-reported data from a selected group with no verification that outcomes were absent at baseline. In contrast, the assessment of outcomes and exposures was measured efficiently, if not with gold-standard means, then through sufficiently robust alternatives. All studies addressed confounding and ensured comparability effectively, particularly those by Trinkoff & Storr (1998), Gold et al. (1992), and Swanson et al. (2023), which employed multifaceted approaches. However, Swanson et al. did not adjust for secondary outcomes, which were the relevant ones for our study, thereby reducing its grade in that aspect.

Discussion

This systematic review looked at substance use among healthcare workers and found that shift workers were generally more likely to consume caffeine, alcohol, and tobacco. While the strength of these associations varied, caffeine use showed the most consistent pattern.

Drawing from ten observational studies conducted across diverse countries and healthcare settings, our review evaluated substance use patterns related to caffeine, alcohol, tobacco, sleep aids, and region-specific stimulants such as khat. While the strength of associations varied by substance and methodology, a consistent pattern emerged: healthcare workers engaged in night or rotating shifts reported higher rates of substance use, particularly caffeine.

Substance use appeared to serve dual functions, helping workers stay alert during extended or overnight shifts, and managing the resulting sleep difficulties and fatigue afterward, highlighting the behavioral adaptations driven by circadian misalignment in this population (Dorrian et al., 2011). However, interpretation of these findings is complicated by considerable heterogeneity in how shift work exposure was defined and measured across studies. While some focused exclusively on night shifts (e.g., Franke et al., 2015; Gold et al., 1992), others exam-

Study ID	Selection	Exposure/Outcome	Comparability	Overall Quality
Kamble et al., 2024*	★★★★	★★	★	Good
Vitale et al., 2023	★★	★★	★★	Moderate
Swanson et al., 2023	★★	★★★	★	Moderate
Buchvold et al., 2019*	★	★★	★	Moderate
Haile et al., 2019	★★	★★★	★★★	Good
Franke et al., 2015	★★	★★	★	Moderate
Flo et al., 2012	★	★★	★★	Moderate
Gamble et al., 2011	★	★★	★★	Moderate
Trinkoff & Storr, 1998	★★	★★	★★★	Moderate
Gold et al., 1992	★★	★	★★	Moderate

Maximum scores are 2 for Selection, 4 for Exposure/Outcome, and 3 for Comparability unless otherwise indicated. *Modified criteria applied in select studies: maximum of 4 for Selection and 2 for Exposure/Outcome due to study design.

Table 4: *Quality assessment of included studies.*

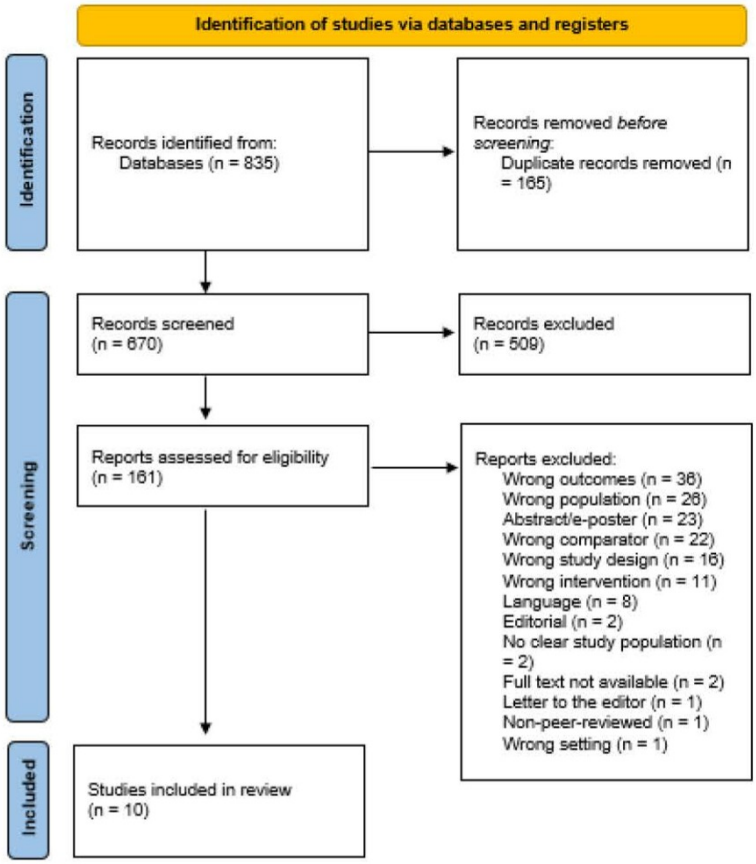

Figure 1: *PRISMA flow diagram for the systematic review.*

ined rotating schedules combining day, evening, and night work (e.g., Kamble et al., 2024; Trinkoff & Storr, 1998). Definitions of exposure thresholds also varied, with some requiring a minimum number of night shifts per month or years of rotating work, further limiting direct comparability. Future studies should align with the International Labour Organization's (ILO) definition of shift work, which encompasses any work schedule that includes hours between 22:00 and 05:00 or involves rotating shifts extending beyond standard daytime schedules. Following ILO recommendations, researchers should report frequency (number of night shifts per month), rotation type, and cumulative years of exposure, enabling clearer assessment of dose–response relationships and harmonization across occupational health studies (ILO, 2019)

This variability extended to measurement tools and control group definitions. Only Haile et al. (2019) applied a formal clinical diagnosis of Shift Work Sleep Disorder using ICSD-3 criteria and validated instruments, while others relied on self-reported schedules or general questionnaires (e.g., Swanson et al., 2023). Similarly, not all studies included clear control groups working regular daytime hours, reducing internal validity and limiting external comparisons. Substance use outcomes were also measured inconsistently: while some studies employed validated tools like the AUDIT-C and PSQI, others used unvalidated or ad hoc surveys, and none used biological markers to confirm use. These methodological inconsistencies restrict the strength of inferences and highlight the need for more standardized research approaches.

Even in light of these inconsistencies, certain patterns stood out, caffeine use was the most consistently associated with shift work, reported in seven of the ten studies. Its accessibility, cultural acceptability, and immediate stimulant effects likely contribute to its frequent use among healthcare professionals (Lieberman et al., 2020; McLellan et al., 2016). Younger workers in particular appeared more reliant on caffeine (Franke et al., 2015), and night-shift nurses frequently cited caffeine as a coping tool (Gamble et al., 2011). By contrast, findings on alcohol and tobacco were more variable. Some studies reported significant associations with shift work (e.g., Trinkoff & Storr, 1998), while others did not (e.g., Buchvold et al., 2019). Use of sleep aids such as melatonin or sedatives was reported in several studies but often failed to reach statistical significance, largely due to small sample sizes and inconsistent measurement (Flo et al., 2012).

Demographic and methodological differences also contributed to variability. Nurses were the dominant study population, limiting generalizability to other healthcare roles, while physicians, particularly surgeons, were underrepresented (Franke et al., 2015). Gender balance varied widely, with female-dominated samples in some studies (Gold et al., 1992) and male-dominated in others (Franke et al., 2015). Geographically, studies spanned the U.S., Europe, Asia, and Africa, with unique substance use patterns like khat in Ethiopia (Haile et al., 2019) that may not apply elsewhere. Most studies (8 of 10) were cross-sectional, limiting causal inference, with only one cohort (Buchvold et al., 2019) and one case-control study (Kamble et al., 2024). Variability in clinical settings, lack of dose-response analysis, and inconsistent use of validated tools further limit internal validity and the ability to draw strong conclusions.

Given these findings, there is an urgent need for evidence-based interventions to support the well-being of shift-working healthcare professionals, especially residents, who face intense workloads, irregular hours, and high stress early in their careers. Despite regulations like the Accreditation Council for Graduate Medical Education's 80-hour cap, many residents exceed this limit (Mechaber & Levine, 2005; Ishikawa et al., 2022), increasing their risk of sleep deprivation and substance use. Structured sleep hygiene education, limits on consecutive night shifts, and confidential access to mental health and substance use services are essential. System-level solutions, such as fatigue risk management systems used in aviation (Mead, 2020), could shift responsibility from individuals to institutions. While the ILO has advocated for stronger protections (ILO, 2012), implementation remains inconsistent. Notably, our review reveals a gap in research linking shift work directly to substance use, despite evidence suggesting a feedback loop between sleep disruption and reliance on substances. Addressing this is critical for both workforce resilience and patient safety (Lockley et al., 2007).

However, caution is needed when generalizing the findings of this review. Most studies focused on nurses (Adriaenssens et al., 2012; Jalilian et al., 2021), with limited inclusion of physicians (Soler-Gonzalez et al., 2005), potentially restricting applicability to a broader healthcare workforce. While this shows the composition of staff in many clinical settings, it could also limit the generalizability of the findings to other allied health workers into health systems. Many studies have predominantly female participants (Jalilian et al., 2021), which may limit conclusions about gender-related differences. Although the studies spanned diverse countries, including the U.S., Norway, Ethiopia, and India (Dorrian et al., 2011; Jemal et al., 2023; Prapanjaroensin et al., 2017), differences in cultural norms, workplace conditions, and

substances assessed may reduce cross-context comparability. Furthermore, most studies did not specify whether participants worked in high-stress areas like ICUs or in outpatient settings, which likely impacts both shift-related fatigue and substance use behaviors (Loef et al., 2022; Prapanjaroensin et al., 2017). These gaps underscore the need for more granular research with clearly defined populations, clinical settings, and role-specific stressors.

Critically, most studies did not specify whether participants worked in high-stress areas like emergency departments (EDs), intensive care units (ICUs), or operating rooms (ORs), versus lower-acuity settings such as outpatient clinics or general medical-surgical wards. This represents a major gap in the literature, as clinical setting may be an even stronger determinant of substance use than professional role alone. Emergency departments and ICUs are characterized by unpredictable patient acuity, rapid decision-making under pressure, life-or-death consequences, and trauma exposure—factors that compound the physiological stress of shift work and are strongly associated with maladaptive coping strategies including substance use (Owen et al., 2023; Vinicius Santinelli Pestana et al., 2022). However, large-scale studies examining work schedules and substance use among nurses typically do not differentiate between high-stress and lower-acuity settings (Yoon et al., 2025), and qualitative research, while highlighting the role of contextual stressors in driving self-medication behaviors, is not designed to compare across clinical environments (Cousin et al., 2022). The absence of setting-specific analyses limits our understanding of who is most at risk and under what conditions. Future research must systematically examine substance use patterns across specific clinical environments, shift intensities, and patient acuity levels to identify targeted intervention points and design workplace policies that address the unique demands of high-stress healthcare settings.

In spite of these challenges, this review has several strengths and synthesizes evidence across geographic and professional contexts. The consistent patterns observed, especially regarding caffeine and alcohol use, provide a valuable foundation for future occupational health interventions. However, limitations must be acknowledged. Reliance on self-reported data, raising the risk of recall and social desirability bias; definitions and measures of shift work and substance use varied, and clinical settings or shift schedules were often poorly described. Because the preregistered search was not broadened post hoc; heterogeneity in terminology (e.g. healthcare workers embedded within general workforce cohorts) may have led to missed studies. Additionally, the predominance of cross-sectional designs and the limited use of validated instruments restrict the ability to draw causal conclusions. Future research should incorporate longitudinal designs, consistent exposure measures, and broader professional representation to strengthen the evidence base. Addressing these methodological gaps will be essential to developing effective interventions to mitigate substance use risks among shift-working healthcare professionals.

The evidence synthesized in this review reveals a consistent and concerning pattern: healthcare professionals exposed to night and rotating shift work, report higher rates of substance use, most notably caffeine, as a means of coping with sleep disruption and occupational stress. These findings underscore the critical intersection between work schedules, behavioral health, and clinical safety. While methodological inconsistencies limit causal inference, the recurring association between disrupted circadian rhythms and substance use behaviors signals an urgent need for institutional reforms. Standardizing exposure definitions, improving measurement tools, and expanding the scope of research to include a broader range of roles and settings will be critical to guiding effective interventions. Ultimately, improving the working conditions of shift-based clinicians is essential not only for their well-being but also for the safety and sustainability of healthcare systems.

Conclusion

Although causality cannot be established due to the predominance of cross-sectional designs, these findings highlight the importance of proactive occupational health strategies. Institutions could implement fair scheduling and fatigue risk management policies. They could also integrate confidential screening and early detection programs for substance misuse among the staff and promote campaigns targeting sleep hygiene education, stress management, physical activity and mindfulness to reduce reliance on stimulants or sedatives. These interventions are low risk and can be considered while future longitudinal studies further clarify causal mechanisms.

Supplementary Materials

Search strategy implemented for each database; definition of shift work and control group according to included studies.

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Conflicts of Interest

The authors declare no conflict of interest.

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