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Tinjauan Pustaka

FAKTOR OKUPASIONAL YANG BERKAITAN DENGAN INFARK MIOKARD AKUT PADA DEWASA USIA KERJA: TINJAUAN NARATIF TERSTRUKTUR

OCCUPATIONAL FACTORS ASSOCIATED WITH ACUTE MYOCARDIAL INFARCTION IN WORKING-AGE ADULTS: A STRUCTURED NARRATIVE REVIEW

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A B S T R A K

Infark miokard akut (IMA) tetap menjadi penyebab utama kematian, disabilitas, dan pemanfaatan layanan kesehatan di seluruh dunia. Selain faktor risiko kardiovaskular konvensional, pajanan dan kondisi kerja dapat memengaruhi kejadian IMA serta luaran setelahnya. Tinjauan naratif terstruktur ini bertujuan menyintesis bukti mengenai faktor okupasional yang berkaitan dengan IMA pada populasi usia kerja. Pencarian terfokus dilakukan di PubMed pada 2 Februari 2026 untuk artikel lengkap berbahasa Inggris yang diterbitkan antara Januari 2010 dan Januari 2026. Dari 108 rekaman yang ditemukan, delapan studi kohort memenuhi kriteria dan dimasukkan sebagai bukti inti. Kualitas metodologis dinilai menggunakan JBI Critical Appraisal Tool for Cohort Studies, dan temuan disintesis berdasarkan domain pajanan. Luaran mencakup kejadian pertama IMA, penyakit jantung koroner yang secara eksplisit mencakup IMA, serta mortalitas atau prognosis setelah IMA. Pajanan diesel engine exhaust menunjukkan hubungan positif paling konsisten dengan kejadian IMA, sedangkan temuan mengenai respirable crystalline silica atau quartz tidak konsisten. Hubungan kerja malam, kerja bergilir, dan travelling work umumnya moderat atau terbatas pada kelompok tertentu. Aktivitas fisik okupasional tidak menunjukkan hubungan yang konsisten, sedangkan ketidakstabilan pekerjaan berkaitan dengan mortalitas dua tahun yang lebih tinggi setelah IMA. Heterogenitas pajanan, metode penilaian, dan definisi luaran membatasi perbandingan langsung dan kesimpulan kausal.

A B S T R A C T

Acute myocardial infarction (AMI) remains a major cause of mortality, disability, and healthcare utilisation worldwide. In addition to conventional cardiovascular risk factors, workplace exposures and employment conditions may influence AMI occurrence and subsequent outcomes. This structured narrative review synthesised evidence on occupational factors associated with AMI among working-age populations. A focused PubMed search was conducted on 2 February 2026 for full-text English-language articles published from January 2010 to January 2026. Of 108 records identified, eight cohort studies met the eligibility criteria and formed the core evidence set. Methodological quality was assessed using the JBI Critical Appraisal Tool for Cohort Studies, and findings were synthesised by exposure domain. Outcomes included first-time AMI, coronary heart disease outcomes explicitly including AMI, and mortality or prognosis following AMI. Occupational diesel engine exhaust exposure showed the most consistent positive association with incident AMI, whereas findings for respirable crystalline silica or quartz were inconsistent. Associations involving night work, shift work, and travelling work were generally modest or limited to specific subgroups. Occupational physical activity was not consistently associated with AMI, while unstable employment was associated with higher 2-year mortality following AMI. Heterogeneity in exposure definitions, assessment methods, and outcome classification limited direct comparison and causal interpretation.

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INTRODUCTION

Acute myocardial infarction (AMI) is one of the most severe clinical manifestations of ischaemic heart disease and remains a major cause of premature mortality, disability, and healthcare utilisation worldwide. Although age-standardised mortality from cardiovascular disease has declined in many regions, its absolute burden remains substantial because of population growth, population ageing, and persistent exposure to modifiable risk factors. Ischaemic heart disease continues to rank among the leading causes of death globally, emphasising the importance of identifying preventable determinants of acute coronary events.[1] Conventional modifiable risk factors, including smoking, hypertension, diabetes mellitus, dyslipidaemia, obesity, and physical inactivity, are well established; however, conditions encountered in the workplace may represent additional and comparatively under-recognised contributors to cardiovascular risk.[2]

Occupational exposure extends beyond job title or occupational category and encompasses the cumulative effects of chemical and particulate agents, physical workload, work schedules, organisational arrangements, psychosocial demands, and employment conditions. These factors may influence cardiovascular health through multiple and potentially interacting pathways. Inhaled particles and chemical agents may induce oxidative stress, systemic inflammation, endothelial dysfunction, autonomic imbalance, platelet activation, and accelerated atherosclerosis.[3] Organisational and psychosocial exposures may contribute through circadian disruption, sleep deprivation, sustained neuroendocrine activation, adverse health behaviours, and reduced opportunities for physiological recovery. Employment instability may additionally affect healthcare access, treatment adherence, financial security, and chronic psychological stress. Consequently, the occupational contribution to AMI is likely to reflect a combination of direct biological effects and broader organisational and socioeconomic processes.[2–4]

Recent cohort evidence has strengthened the proposed association between occupational exposure to chemical and particulate agents and AMI, although the consistency of the findings varies according to the type of exposure and the assessment method used. In a nationwide Swedish cohort, Grahn et al[5] reported that occupational exposure to several chemicals and particles, including diesel engine exhaust, polycyclic aromatic hydrocarbons, sulphur dioxide, and selected metals, was associated with an increased incidence of first-time myocardial infarction. Some associations were more pronounced among women, suggesting possible sex-related differences in occupational exposure patterns, biological susceptibility, or occupational selection. Similarly, Wiebert et al[6] observed an association between cumulative occupational exposure to respirable crystalline silica and AMI, with stronger estimates among women than among men.

Evidence concerning specific particulate exposures remains heterogeneous. A large Danish register-based cohort demonstrated modest increases in first-time AMI associated with cumulative and recent occupational exposure to diesel engine exhaust.[7] In contrast, a related analysis of occupational exposure to respirable crystalline quartz found no increased AMI risk after comprehensive adjustment and reported inverse estimates in some highly exposed groups.[8] These contrasting findings illustrate how exposure modelling, occupational history, residual confounding, sex distribution, and the healthy worker survivor effect may influence risk estimates in occupational cohort studies.

Work schedules and organisational characteristics represent another potential pathway linking employment conditions to coronary events. An umbrella review of epidemiological evidence identified associations between shift work and several adverse health outcomes, with suggestive evidence concerning myocardial infarction.[9] In the Kuopio Ischaemic Heart Disease Risk Factor Study, Wang et al[10] found that travelling work, characterised by frequent overnight absence from home, was associated with an increased risk of AMI among men with pre-existing ischaemic heart disease, whereas no clear association was observed among men without pre-existing disease. These findings suggest that the cardiovascular consequences of non-standard work schedules may be modified by baseline cardiovascular susceptibility.

Among Danish healthcare workers, Vestergaard et al[11] reported a modestly elevated incidence of coronary heart disease among male night workers, although the associations were not consistent across quantitative measures of night-work intensity and duration. Circadian misalignment, inadequate sleep, metabolic disturbance, autonomic dysregulation, and occupation-specific stressors may partly explain the observed associations. Nevertheless, variation in shift-work definitions, exposure timing, occupational setting, and outcome classification continues to limit direct comparisons across studies.[9–11]

The relationship between occupational physical activity and cardiovascular health is also complex. Unlike leisure-time physical activity, which generally involves shorter periods of dynamic activity followed by adequate recovery, occupational physical activity may involve prolonged standing, repetitive movement, static loading, heavy lifting, and limited recovery. This distinction has been described as the physical activity paradox, whereby higher occupational physical activity does not necessarily produce the cardiovascular benefits associated with leisure-time exercise and may, under certain conditions, be associated with less favourable outcomes.[12]

In the Swedish Work, Lipids, and Fibrinogen cohort, Johnsen et al[13] found no significant overall association between occupational physical activity and myocardial infarction. A lower risk was observed among younger workers engaged in lifting and carrying, but this finding was not consistent across age groups or physical-activity categories. These results indicate that the cardiovascular implications of occupational activity may depend on its intensity, duration, type, worker age, baseline cardiorespiratory fitness, and opportunities for recovery.[12,13]

Occupational circumstances may also influence outcomes after an acute coronary event rather than only its initial occurrence. Zhu et al[14] reported substantial differences in baseline characteristics, treatment patterns, and long-term outcomes across occupational groups in a multicentre prospective registry of patients with AMI in China. Unstable employment was independently associated with increased mortality during the 2 years following AMI, whereas patients in stable white-collar employment generally experienced more favourable outcomes. Although this study examined post-AMI prognosis rather than incident AMI, it highlights the broader relevance of employment conditions across the cardiovascular disease continuum. Occupational status may capture interconnected differences in socioeconomic resources, job security, healthcare access, health literacy, psychosocial stress, and adherence to secondary-prevention strategies.[4,14]

Despite the growing literature, evidence concerning occupational factors and AMI remains dispersed across distinct exposure domains. Individual studies have generally focused on a specific chemical agent,[5–8] occupational schedule,[9–11] physical demand,[12,13] or employment characteristic,[4,14] while differences in population composition, exposure assessment, comparator definition, covariate adjustment, and cardiovascular endpoints complicate comparisons across studies.[5–14] Moreover, much of the available evidence originates from Scandinavian and other high-income settings,[5–8,10,11,13] potentially limiting its applicability to labour markets with different regulatory, socioeconomic, and occupational-health conditions. A structured synthesis is therefore needed to clarify the principal exposure domains that have been investigated, identify consistencies and discrepancies in the reported associations, and define the methodological limitations and evidence gaps relevant to occupational cardiovascular prevention.

Accordingly, this structured narrative review aimed to synthesise and critically interpret evidence from eight core cohort studies examining occupational factors in relation to AMI among working-age adults. The review considered occupational exposure to chemical and particulate agents, work schedules and organisational characteristics, occupational physical activity, and employment-related factors. It encompassed evidence concerning incident AMI, coronary heart disease outcomes explicitly including AMI, and prognosis following AMI, while maintaining these endpoints as distinct outcome categories. The review also examined how differences in population characteristics, exposure-assessment methods, outcome definitions, and methodological quality may account for variation in the direction and magnitude of the reported associations.

METHOD

Review Design

This study was conducted as a structured narrative review with a focused literature search. This approach was selected because the available studies investigated heterogeneous occupational exposures, populations, exposure-assessment methods, and acute myocardial infarction (AMI)-related outcomes that were not sufficiently comparable for quantitative pooling. The review was designed to provide a transparent, structured, and critically informed synthesis of cohort evidence concerning occupational factors and AMI among working-age adults.

The preparation and reporting of this review were informed by the Scale for the Assessment of Narrative Review Articles (SANRA),[15] with particular attention to the justification of the review topic, explicit statement of the review objective, transparent description of the literature search, appropriate referencing, scientific reasoning, and presentation of relevant outcome data.[16]

Review Question and Scope

The review was guided by the following question: Which occupational factors have been reported in association with acute myocardial infarction and related coronary outcomes among working-age adults, and how do differences in occupational exposure, population characteristics, exposure assessment, and outcome definition influence the reported associations?

The scope of the review comprised four principal occupational domains: chemical and particulate exposures, work schedules and organisational characteristics, occupational physical activity, and employment-related factors. Because the identified cohort studies used different cardiovascular endpoints, the outcome scope included: (1) incident or first-time AMI; (2) coronary heart disease outcomes that explicitly included AMI as a component; and (3) mortality or prognosis following AMI. These outcome categories were retained as distinct categories during data extraction, synthesis, and interpretation.

Literature Identification and Search Strategy

The literature-identification process was conducted iteratively. An initial exploratory search identified eight potentially relevant cohort studies and informed the development of the occupational domains examined in this review. A reproducible focused search was subsequently conducted in PubMed on 2 February 2026 to retrieve studies addressing these domains and to verify the relevance of the initially identified articles.

The PubMed search was restricted to English-language articles published between January 2010 and January 2026 and available through the full-text filter. The search combined terms related to myocardial infarction, occupation, selected occupational exposure domains, and cohort study design. The following Boolean search string was used: (**acute myocardial infarction** OR **myocardial infarction**) AND **occupation*** AND (**respirable crystalline silica** OR **physical activity** OR **chemicals** OR **respirable crystalline quartz** OR **status** OR **diesel engine exhaust** OR **shift work**) AND **cohort**.

The search retrieved 108 records. All records were imported into Mendeley Desktop for reference management and duplicate checking. The reference lists of the included studies were also examined, and targeted supplementary searches were undertaken to identify epidemiological, methodological, and mechanistic literature relevant to the interpretation of the findings.

Eligibility Criteria

Studies were eligible for inclusion when they met all of the following criteria: (1) the study used a prospective, occupational, population-based, or registry-based cohort design; (2) the study population consisted of working-age adults, occupationally active individuals, workers from a defined occupational group, or individuals whose employment status could be clearly identified; (3) the exposure represented an occupational or employment-related factor; (4) the study reported incident AMI, a coronary heart disease outcome that explicitly included AMI, or mortality or prognosis following AMI; (5) the study presented original quantitative data; and (6) the association was reported using an effect estimate, such as a hazard ratio, incidence rate ratio, relative risk, or odds ratio, with a corresponding confidence interval.

Eligible occupational factors included exposure to chemical and particulate agents, physical workload, occupational physical activity, shift or night work, travelling work, employment category, and employment stability. Exposure assessment could be based on questionnaires, administrative or payroll records, occupational classifications, job-exposure matrices, quantitative exposure models, or environmental measurement data.

Studies were excluded when they did not report original cohort data, did not assess an occupational or employment-related factor, did not report an AMI-related or explicitly relevant coronary outcome, did not provide a quantitative estimate of association, or were not available as full-text English-language publications within the specified publication period.

Study Selection

All records retrieved from PubMed underwent title and abstract screening. Records considered potentially relevant were subsequently assessed through full-text review. The lead author conducted the initial screening and eligibility assessment. Two expert reviewers independently verified the title and abstract screening decisions, full-text eligibility assessments, and final classification of the included studies.

The eight studies identified during the exploratory phase were reassessed against the predefined eligibility criteria rather than being retained automatically. All eight studies fulfilled the revised criteria and were included in the final synthesis. Any disagreement concerning eligibility, outcome classification, or thematic categorisation was resolved through discussion among the lead author and the two expert reviewers until consensus was reached.

The included studies were categorised into four thematic domains: (1) occupational chemical and particulate exposures; (2) work schedules and organisational characteristics; (3) occupational physical activity; and (4) employment status and employment stability. Studies reporting composite coronary outcomes or post-AMI prognosis were distinguished from studies examining incident AMI to avoid treating different cardiovascular endpoints as directly equivalent.

Data Extraction and Verification

Data were extracted using a standardised evidence-extraction form developed for this review. The extracted variables included author and year of publication, country and study setting, study design, cohort characteristics, sample size, participant age and sex, occupational group, exposure definition, exposure-assessment method, exposure duration or timing, comparison group, cardiovascular outcome definition, outcome-ascertainment method, follow-up duration, statistical model, adjusted covariates, effect estimates, 95% confidence intervals, and principal findings.

The lead author performed the initial data extraction. All extracted information was independently verified by two expert reviewers against the corresponding full-text publications. Differences in data transcription or interpretation were resolved through re-examination of the original article and consensus discussion.

Particular attention was given to differences in occupational exposure assessment, including self-reported work characteristics, administrative employment records, payroll-based shift information, job-exposure matrices, and quantitative estimates of cumulative or recent exposure. Outcome definitions were also examined carefully to distinguish incident or first-time AMI from composite coronary heart disease outcomes and post-AMI mortality.

Methodological Quality Appraisal

The methodological quality and risk of bias of the eight included cohort studies were assessed using the revised JBI Critical Appraisal Tool for Cohort Studies.[17] The tool comprises 11 questions addressing potential bias related to participant selection, exposure classification, confounding, temporal precedence, outcome measurement, follow-up, participant retention, and statistical analysis.

Each appraisal item was rated as “yes”, “no”, “unclear”, or “not applicable”. The lead author completed the initial appraisal, and all ratings were independently verified by two expert reviewers. Differences in appraisal decisions were resolved through discussion and re-examination of the relevant methodological information in the original articles.

No overall numerical score or minimum cut-off value was applied because individual methodological domains may have different implications for the validity of each study. No study was excluded solely on the basis of the appraisal findings. Instead, the appraisal results were used to inform the interpretation of the strength, consistency, and limitations of the evidence. Particular attention was given to exposure misclassification, residual confounding, outcome specificity, incomplete adjustment for conventional cardiovascular risk factors, and the potential healthy worker or healthy worker survivor effect.

Data Synthesis

A meta-analysis was not performed because the included studies differed substantially in occupational exposure definitions, exposure metrics, comparison groups, study populations, follow-up periods, covariate adjustment, and cardiovascular outcome definitions. The findings were therefore synthesised narratively.

The narrative synthesis was organised according to the four occupational domains. Within each domain, studies were compared according to the direction and magnitude of the reported association, statistical precision, evidence of an exposure–response relationship, cumulative versus recent exposure, sex- and age-specific findings, baseline cardiovascular vulnerability, exposure-assessment method, outcome definition, and principal methodological limitations.

Effect estimates were reported using the measures presented in the original studies and were not converted into a common statistical metric. The findings were interpreted as associations and were not regarded as evidence of causality. Results from studies of incident AMI were interpreted as evidence concerning disease occurrence, whereas findings from studies of composite coronary outcomes and post-AMI mortality were treated as complementary evidence concerning related coronary morbidity and prognosis.

Ethical Considerations

This review used information from previously published studies and did not involve participant recruitment, collection of primary individual-level data, or access to identifiable personal information. Institutional ethical approval and informed consent were therefore not required.

RESULTS

Study Selection

The focused PubMed search identified 108 records. No duplicate records were identified; therefore, all records proceeded to title and abstract screening. A total of 100 records were excluded because they did not meet the predefined eligibility criteria concerning study design, occupational exposure, study population, or cardiovascular outcome. Eight articles underwent full-text assessment, and all eight met the eligibility criteria and were retained in the core evidence synthesis. The included studies were published between 2016 and 2026.

Table 1. Summary of the Study-Selection Process

Selection stage	Records, No.
Records identified through PubMed	108
Duplicate records removed	0
Records screened by title and abstract	108
Records excluded after title and abstract screening	100
Full-text articles assessed for eligibility	8
Studies included in the core evidence synthesis	8

Characteristics of the Included Studies

The eight core studies were conducted in Sweden, Denmark, Finland, and China. Three studies were based on Swedish cohorts,[5,6,13] three used Danish national or occupational register-based cohorts,[7,8,11] one was conducted within a Finnish prospective cohort,[10] and one used a multicentre prospective AMI registry in China.[14] The study populations ranged from 1,891 middle-aged working men to nationwide cohorts comprising more than 900,000 workers.

Table 2. Characteristics and Principal Findings of the Eight Core Studies

Study	Population/setting	Exposure assessment	Outcome	Principal findings
Grahn et al, 2025[5]	Swedish nationwide employed cohort, born 1930–1990; employed 1985–2013; no previous MI; follow-up 1986–2017	Thirty-one occupational chemicals and particles estimated using SweJEM	First-time MI from national hospital and mortality registers	Among 225,366 incident cases, higher MI risks were reported for diesel exhaust, PAHs, sulphur dioxide, cadmium, chromium, iron, and lead. Estimates were generally higher in women. The attributable proportion among exposed workers was approximately 9%.
Wiebert et al, 2023[6]	605,246 men and 480,607 women in Swedish manual occupations	Cumulative RCS exposure estimated using a JEM	First-time AMI from national registers	Ever exposure was associated with HRs of 1.29 (95% CI 1.15–1.46) in women and 1.02 (1.00–1.04) in men. In the highest exposure quartile, the corresponding HRs were 1.66 (1.27–2.18) and 1.06 (1.03–1.10), with exposure–response trends in both sexes.
Wils et al, 2025[7]	903,415 Danish wage earners aged 35–50 years; follow-up 1996–2018	Cumulative, maximum, and recent DEE exposure estimated using a quantitative JEM	First-time AMI from national patient and mortality registers	There were 35,511 events during 19.36 million person-years. The fully adjusted IRR was 1.08 (95% CI 1.04–1.12) at or above the 75th cumulative-exposure percentile. Among exposed workers, recent-exposure quartile 4 had an IRR of 1.15 (1.05–1.27).
Wils et al, 2026[8]	Danish DOC*X Dust cohort of 903,415 workers; follow-up 1996–2018	Cumulative, maximum, and recent RCQ exposure estimated using SYN-JEM	First-time AMI from national hospital registers	Positive associations in minimally adjusted analyses disappeared after comprehensive adjustment. The highest cumulative-exposure quartile had an IRR of 0.87 (95% CI 0.83–0.92). The inverse estimates may have been influenced by the healthy worker survivor effect.
Wang et al, 2016[10]	1,891 Finnish men aged 42–60 years; approximately 20 years of follow-up	Baseline night, rotating-shift, and travelling-work measures	Incident AMI	Travelling work involving at least 3 nights per week away from home was associated with AMI in men with pre-existing IHD (HR 2.45; 95% CI 1.08–5.59), but not in those without IHD (HR 0.93; 0.43–2.00). Other work schedules showed no clear associations.
Vestergaard et al, 2023[11]	100,149 night workers and 153,882 day workers in Danish healthcare; follow-up 2007–2015	Night-work characteristics obtained from daily payroll records	First-time CHD, defined as angina or MI	Compared with day workers, the IRR was 1.06 (95% CI 0.97–1.17) in women and 1.22 (1.07–1.39) in men. No consistent exposure–response relationship was observed across night-work measures.
Johnsen et al, 2016[13]	9,961 Swedish employees without previous MI; mean follow-up 13.1 years	Self-reported sitting, standing or walking, and lifting or carrying at work	Incident MI from national registers	Among 249 incident cases, no significant overall association was observed. In younger workers, lifting or carrying was associated with lower risk than predominantly seated work (HR 0.37; 95% CI 0.17–0.84).
Zhu et al, 2025[14]	11,318 Chinese patients with AMI aged 18–60 years	Occupational category and stable versus unstable employment	In-hospital and 2-year all-cause mortality after AMI	Adjusted mortality did not differ significantly across individual occupational categories. Unstable employment was associated with higher 2-year post-discharge mortality than stable employment (HR 1.639; 95% CI 1.169–2.298).

Abbreviations: AMI, acute myocardial infarction; CHD, coronary heart disease; CI, confidence interval; DEE, diesel engine exhaust; HR, hazard ratio; IHD, ischaemic heart disease; IRR, incidence rate ratio; JEM, job-exposure matrix; MI, myocardial infarction; PAHs, polycyclic aromatic hydrocarbons; RCQ, respirable crystalline quartz; RCS, respirable crystalline silica; SweJEM, Swedish Job Exposure Matrix; SYN-JEM, Synergy Job Exposure Matrix.

Six studies examined incident or first-time AMI as the principal outcome.[5–8,10,13] Vestergaard et al[11] assessed incident coronary heart disease, defined as angina pectoris or myocardial infarction, whereas Zhu et al[14] investigated in-hospital and 2-year mortality among patients who had already experienced AMI. These outcomes were retained as complementary evidence concerning AMI-related coronary morbidity and post-AMI prognosis, respectively, and were not treated as equivalent to incident AMI.

Occupational factors were assessed using several approaches. Four studies used job-exposure matrices or quantitative exposure models to estimate exposure to chemical or particulate agents.[5–8] Two studies used questionnaire-based assessments of work schedules or occupational physical activity,[10,13] one used day-by-day payroll records to quantify night-work exposure,[11] and one classified participants according to occupational status and employment stability.[14]

Methodological Quality Appraisal

The JBI Critical Appraisal Checklist for Cohort Studies was applied to the eight core studies. The item-level appraisal is presented in Table 3. The studies generally demonstrated several methodological strengths, including longitudinal cohort designs, consistent exposure-assessment procedures across comparison groups, identification and statistical control of relevant confounders, sufficiently long follow-up periods, and appropriate statistical analyses.

The national register-based studies benefited from large study populations and objective ascertainment of AMI or coronary outcomes through hospital-discharge and mortality registers.[5–8,11] The principal methodological concern in studies using job-exposure matrices was the possibility of exposure misclassification because group-level occupational estimates may not fully represent individual variation in tasks, exposure intensity, or protective measures.[5–8]

The validity of exposure measurement was rated as unclear for the questionnaire-based studies by Wang et al[10] and Johnsen et al[13] because exposure was assessed at baseline and changes in work schedules or physical demands during follow-up may not have been captured. Exposure measurement was also rated as unclear for Zhu et al[14] because occupational status was represented by broad employment categories. In that study, the comparison groups also differed substantially in socioeconomic and clinical characteristics at baseline, although these differences were addressed through multivariable adjustment.

No study was excluded on the basis of the methodological appraisal. The item-level findings were used to contextualise the direction, magnitude, and consistency of the reported associations.

JBI appraisal questions: Q1, Were the two groups similar and recruited from the same population? Q2, Were the exposures measured similarly to assign participants to the exposed and unexposed groups? Q3, Was the exposure measured in a valid and reliable manner? Q4, Were confounding factors identified? Q5, Were strategies to address confounding factors stated? Q6, Were the participants free of the outcome at the start of the study or at the time of exposure? Q7, Were the outcomes measured in a valid and reliable manner? Q8, Was the follow-up period reported and sufficiently long for the outcome to occur? Q9, Was follow-up complete, and, if not, were the reasons for loss to follow-up described and explored? Q10, Were strategies used to address incomplete follow-up? Q11, Was an appropriate statistical analysis used?

Occupational Chemical and Particulate Exposures

Four studies examined occupational exposure to chemical or particulate agents.[5–8] Grahn et al[5] reported positive associations between first-time myocardial infarction and several combustion products, particles, and metals. Diesel exhaust, polycyclic aromatic hydrocarbons, sulphur dioxide, cadmium, chromium, iron, and lead were among the exposures associated with increased risk. The estimated attributable proportion of myocardial infarction among exposed workers was approximately 9%.

The two studies of crystalline silica or quartz produced contrasting findings. Wiebert et al[6] reported an exposure–response relationship between cumulative respirable crystalline silica exposure and AMI among both men and women. Relative estimates were higher among women, particularly in the highest cumulative-exposure quartile. In contrast, Wils et al[8] found no increased AMI risk associated with respirable crystalline quartz after comprehensive adjustment. Fully adjusted estimates were inverse in the higher exposure categories.

Evidence concerning occupational diesel engine exhaust was more consistent. Wils et al[7] found that increasing cumulative exposure was associated with higher AMI incidence. The highest cumulative-exposure category was associated with an IRR of 1.08, whereas the highest recent-exposure category was associated with an IRR of 1.15 when the analysis was restricted to exposed workers. These findings

Table 3. JBI Critical Appraisal of the Eight Core Cohort Studies

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
Grahn et al[5]	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y
Wiebert et al[6]	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y
Wils et al, diesel engine exhaust[7]	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y
Wils et al, respirable crystalline quartz[8]	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y
Wang et al[10]	Y	Y	U	Y	Y	Y	Y	Y	Y	NA	Y
Vestergaard et al[11]	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y
Johnsen et al[13]	Y	Y	U	Y	Y	Y	Y	Y	Y	NA	Y
Zhu et al[14]	N	Y	U	Y	Y	Y	Y	Y	Y	NA	Y

Abbreviations: NA, not applicable; N, no; U, unclear; Y, yes.

were directionally consistent with those of Grahn et al,[5] in which diesel exhaust was among the occupational agents associated with first-time myocardial infarction.

Work Schedules and Organisational Characteristics

Two studies examined work schedules and organisational characteristics.[10,11] Wang et al[10] found that travelling work was associated with an increased risk of AMI among men with pre-existing ischaemic heart disease. No corresponding association was observed among men without pre-existing disease, and no clear associations were identified for the other work-schedule categories.

Vestergaard et al[11] reported a higher incidence of coronary heart disease among male night workers than among male day workers. The corresponding association among women was not statistically significant. Although elevated estimates were observed in some high-exposure categories, no consistent exposure–response relationship was identified across the quantitative measures of night-work frequency, duration, rotation, or consecutive shifts.

Occupational Physical Activity

Johnsen et al[13] found no statistically significant overall association between occupational physical activity and incident myocardial infarction. Neither predominantly standing or walking work nor work involving lifting or carrying was consistently associated with myocardial infarction in the overall cohort. A lower risk was observed among younger workers whose employment involved lifting or carrying; however, this finding was confined to an age-stratified analysis and was not observed among older workers.

Employment Status and Post-AMI Outcomes

Zhu et al[14] examined occupational status in relation to outcomes among patients who had already experienced AMI. The occupational groups differed in demographic characteristics, cardiovascular risk profiles, clinical presentation, access to care, and treatment patterns. After multivariable adjustment, individual occupational categories were not significantly associated with mortality when compared with unemployed patients.

When the occupational categories were grouped according to employment stability, unstable employment was independently associated with higher 2-year post-discharge mortality. Because this study evaluated prognosis after AMI rather than the occurrence of a first AMI, its findings were interpreted as evidence concerning employment-related differences in post-AMI outcomes.

Overall Pattern of Findings

Across the eight core studies, occupational exposure to diesel engine exhaust showed the most consistent positive association with incident AMI.[5,7] Findings for respirable crystalline silica or quartz were inconsistent, with an exposure–response relationship reported in the Swedish cohort but no increased risk after comprehensive adjustment in the Danish cohort.[6,8]

Associations involving work schedules were generally modest or restricted to particular subgroups, including men with pre-existing ischaemic heart disease and male healthcare workers engaged in night work.[10,11] Occupational physical activity was not consistently associated with AMI in the overall study population,[13] whereas unstable employment was associated with less favourable long-term survival following AMI.[14]

The direction and magnitude of the reported associations varied according to exposure type, sex, baseline cardiovascular status, exposure-assessment method, covariate adjustment, and outcome definition. Incident AMI, composite coronary heart disease, and post-AMI mortality were therefore maintained as distinct outcome categories throughout the synthesis.

DISCUSSION

Principal Findings

This structured narrative review synthesised evidence from eight cohort studies examining occupational factors in relation to incident acute myocardial infarction (AMI), coronary outcomes that included AMI, and post-AMI prognosis. The findings indicate that occupational cardiovascular risk cannot be attributed to a single exposure pathway. Instead, the available evidence encompasses exposure to chemical and particulate agents, disruption associated with non-standard work schedules, physical demands at work, and broader employment-related conditions. Occupational exposure to diesel engine exhaust showed the most consistent positive association with incident AMI, whereas findings for respirable crystalline silica or quartz were heterogeneous. Associations involving night work, travelling work, and other non-standard work schedules were generally modest or restricted to susceptible subgroups. Occupational physical activity was not consistently associated with AMI in the overall population, while unstable employment was associated with less favourable outcomes after AMI. [5–8,10,11,13,14]

These findings should be interpreted according to the specific cardiovascular outcome examined. Six of the eight core studies evaluated incident or first-time AMI.[5–8,10,13] By contrast, Vestergaard et al[11] used a composite coronary heart disease outcome that included angina pectoris and myocardial infarction, whereas Zhu et al[14] evaluated mortality among patients who had already experienced AMI. The latter studies broaden the review by demonstrating that occupational and employment-related factors may be relevant not only to the occurrence of an acute coronary event but also to subsequent morbidity and prognosis. Nevertheless, these outcomes represent different stages of the cardiovascular disease continuum and should not be interpreted as directly equivalent.

Chemical and Particulate Occupational Exposures

The most consistent evidence in this review concerned occupational exposure to diesel engine exhaust. Grahn et al[5] identified diesel exhaust among several workplace agents associated with first-time myocardial infarction, while Wils et al[7] reported higher AMI incidence with increasing cumulative and recent diesel exhaust exposure. Although the observed relative increases were modest, their occupational-health relevance may be substantial when exposure is common, prolonged, and experienced by large working populations.

The epidemiological findings are supported by experimental evidence. In a controlled exposure study involving men with stable coronary heart disease, brief exposure to dilute diesel exhaust increased exercise-induced myocardial ischaemia and impaired endogenous fibrinolytic capacity.[18] These findings provide biological plausibility for an association between combustion-derived particles and acute coronary events, particularly among individuals with pre-existing atherosclerotic disease. Potential mechanisms include pulmonary oxidative stress, systemic inflammation, endothelial dysfunction, autonomic imbalance, platelet activation, altered vascular reactivity, and reduced fibrinolysis.[3,18] However, controlled short-term exposure studies cannot fully reproduce the complex and variable exposure patterns encountered across an occupational lifetime.

The findings for respirable crystalline silica or quartz were less consistent. Wiebert et al[6] reported an exposure–response relationship between cumulative silica exposure and AMI, with stronger relative estimates among women. In contrast, Wils et al[8] found no positive association after extensive adjustment for socioeconomic, clinical, environmental, and occupational factors. Differences between the studies may reflect variation in the occupational populations, exposure ranges, job-exposure matrices, calendar periods, covariate adjustment, and the construction of cumulative and recent exposure measures. Adjustment for correlated workplace exposures, including diesel exhaust, noise, physical workload, and job strain, may also have influenced the fully adjusted estimates in the Danish cohort.[8]

The inverse associations observed in some of the more highly exposed quartz categories should not be interpreted as evidence of a protective effect. In occupational cohorts, workers who develop symptoms or reduced work capacity may transfer to lower-exposure positions or leave employment, whereas healthier workers remain employed in higher-exposure occupations. This process may produce an apparently lower risk among workers with greater cumulative exposure and is commonly referred to as the healthy worker survivor effect.[19] Such bias is particularly relevant when both exposure and continued employment vary over time.

Sex-specific findings also require cautious interpretation. Grahn et al[5] and Wiebert et al[6] reported stronger relative estimates among women for several occupational exposures. These differences may reflect biological susceptibility, sex-specific occupational tasks, exposure intensity within the same occupational classification, or differences in the distribution of conventional cardiovascular risk factors. Alternatively, the estimates may have been influenced by smaller numbers of exposed women and occupational selection. Further studies using individual-level exposure assessment are needed to determine whether the observed differences represent genuine sex-related susceptibility or methodological variation.

Work Schedules and Organisational Characteristics

The findings concerning non-standard work schedules were heterogeneous. Wang et al[10] reported a strong association between travelling work and AMI among men with pre-existing ischaemic heart disease, whereas no corresponding association was observed among men without previous disease. This pattern suggests that disrupted work, travel, sleep, and recovery may be particularly relevant among workers with established cardiovascular vulnerability rather than having a uniform effect across all working populations.

Vestergaard et al[11] observed a modestly increased incidence of coronary heart disease among male night workers but not among female night workers. However, the absence of a consistent exposure–response pattern across measures of night-work frequency, duration, rotation, and consecutive shifts weakens a simple causal interpretation. The composite outcome, which included both angina pectoris and myocardial infarction, also limits direct comparison with studies restricted to first-time AMI.

Evidence from other prospective cohorts nevertheless supports a possible association between prolonged night-shift work and coronary disease. In the Nurses' Health Studies, longer exposure to rotating night-shift work was associated with a small increase in coronary heart disease risk. The association appeared weaker with increasing time since cessation of shift work.[20] This pattern suggests that both the duration and recency of night-shift exposure may be relevant, although the observational findings do not establish whether the associated coronary risk is reversible after night work ceases.

Experimental studies provide biological plausibility for the cardiovascular effects of disrupted work schedules. Circadian misalignment has been shown to alter glucose regulation, cortisol rhythms, blood pressure, and metabolic function under controlled conditions.[21] Among chronic shift workers, experimentally induced circadian misalignment reduced glucose tolerance independently of behavioural and circadian-phase effects.[22] Repeated circadian disruption, sleep restriction, irregular eating patterns, and inadequate recovery may therefore contribute to coronary risk through insulin resistance, hypertension, dyslipidaemia, inflammation, and adverse autonomic regulation.

Work organisation extends beyond shift scheduling. Large-scale observational evidence has suggested a small association between long working hours and coronary heart disease, although this association has been weaker and less consistent than the corresponding association with stroke.[23] Job strain and effort–reward imbalance have also been associated with incident coronary heart disease in large multicohort analyses.[24,25] These psychosocial exposures were not adequately represented among the eight core studies because of the focused search strategy. Their limited representation in the present synthesis should therefore be considered an evidence gap rather than evidence of absence.

Occupational Physical Activity

Johnsen et al[13] found no overall association between occupational physical activity and incident myocardial infarction. The lower risk observed among younger workers engaged in lifting and carrying was confined to a subgroup and was not reproduced among older workers. This finding should therefore be interpreted cautiously and should not be considered evidence that physically demanding work is generally protective against AMI.

The results are consistent with the concept that occupational and leisure-time physical activity are not physiologically equivalent. Leisure-time exercise is usually performed voluntarily for limited periods, often at sufficient intensity to improve cardiorespiratory fitness, and is followed by recovery. By contrast, occupational physical activity may involve prolonged standing, repetitive movement, static muscular loading, heavy lifting, limited worker control, and inadequate recovery.[12] The cardiovascular consequences of occupational activity may therefore depend on the interaction between workload, cardiorespiratory fitness, psychosocial demands, environmental conditions, and opportunities for rest.

Broad occupational-activity categories may also obscure important differences between individual tasks. Classification into sitting, standing or walking, and lifting or carrying does not fully capture peak workload, static versus dynamic activity, lifting frequency, posture, heat exposure, work pace, or cumulative recovery deficit. More precise assessment using repeated questionnaires, wearable devices, direct observation, and task-specific ergonomic measurements may help distinguish potentially beneficial movement from sustained cardiovascular strain.

Employment Status and Post-AMI Outcomes

The findings of Zhu et al[14] extend the review from occupational determinants of disease occurrence to employment-related differences in prognosis. Although mortality did not differ significantly across individual occupational categories after full adjustment, unstable employment was associated with higher 2-year mortality following AMI. Employment status may capture more than occupational category alone. It may reflect functional capacity, socioeconomic resources, financial security, healthcare access, health literacy, social support, and the ability to participate in secondary-prevention programmes.

Related cohort evidence supports this interpretation. Among working-age patients with AMI, individuals outside the workforce had higher absolute risks of death and recurrent AMI than those who remained employed, although differences in age, comorbidity, education, and social circumstances accounted for part of the observed risk.[26] Socioeconomic disadvantage has also been associated with higher long-term mortality after AMI among younger adults, even after adjustment for clinical characteristics.[27] These findings suggest that employment status may function as a multidimensional marker of pre-existing disadvantage and post-event vulnerability rather than as an isolated causal exposure.

The relationship between employment and cardiovascular outcomes is likely to be bidirectional. Unstable employment may contribute to poorer recovery and reduced access to preventive care, while AMI itself may result in job loss, reduced earnings, and impaired quality of life. A population-based Canadian study demonstrated persistent reductions in employment and earnings after AMI among working-age adults.[28] Similarly, adverse changes in employment status following AMI were associated with poorer health status, greater depressive symptoms, and increased financial difficulty.[29] These consequences may generate a reinforcing cycle in which illness reduces occupational participation and financial security, which subsequently impairs access to rehabilitation and sustained secondary prevention.

Cardiac rehabilitation may be particularly relevant in this context because it integrates exercise, cardiovascular risk-factor management, education, and psychological support. Participation in cardiac rehabilitation has been associated with lower all-cause mortality among patients with cardiovascular disease.[30] Occupationally oriented rehabilitation may additionally address work capacity, graded return to work, workplace adaptation, medication adherence, and coordination among clinicians, workers, employers, and occupational-health professionals. However, the effectiveness of specific employment-focused interventions after AMI requires further prospective evaluation.

Methodological Interpretation

The JBI appraisal identified several methodological strengths across the core studies, including longitudinal cohort designs, large population-based samples, objective register-based outcome ascertainment, and multivariable statistical analyses. These features increase confidence that the occupational exposures generally preceded the measured outcomes and reduce the likelihood of differential outcome ascertainment.

Nevertheless, several limitations affect the interpretation of the evidence. Job-exposure matrices facilitate exposure assessment in large cohorts and reduce reliance on individual recall, but they assign average exposure estimates to occupational groups. They may therefore fail to capture individual variation in work tasks, exposure intensity, protective equipment, workplace controls, and exposure occurring outside the recorded occupation.[5–8] Non-differential exposure misclassification would commonly attenuate associations, although more complex patterns may occur when occupational mobility and continued employment are related to health status.

Questionnaire-based exposure assessment presents different limitations. A single baseline measurement may not represent working conditions throughout prolonged follow-up, particularly when workers change jobs, schedules, or physical duties.[10,13] Repeated exposure assessment would provide stronger evidence by accounting for time-varying working conditions.

Residual confounding also remains possible. Individual-level information on smoking, body mass index, diet, leisure-time physical activity, hypertension, diabetes, and socioeconomic circumstances was not measured consistently across the register-based studies. Adjustment for occupational co-exposures is especially challenging because diesel exhaust, noise, physical workload, and psychosocial strain may occur simultaneously. Statistical adjustment may reduce confounding, but highly correlated exposures can also produce unstable estimates and complicate the interpretation of exposure-specific associations.

Outcome heterogeneity further limits direct comparison. First-time AMI, composite coronary heart disease, and post-AMI mortality represent clinically related but distinct outcomes. The findings most directly relevant to the occurrence of AMI were derived from studies of incident disease, whereas studies of composite coronary outcomes and post-AMI mortality provided complementary evidence concerning coronary morbidity and prognosis.

Implications for Occupational Health and Research

From an occupational-health perspective, the findings support continued efforts to reduce exposure to combustion-derived particles and other potentially cardiotoxic workplace agents. Potential measures include source control, engineering interventions, exposure monitoring, and appropriate personal protection. However, the cardiovascular effectiveness of specific workplace interventions requires direct evaluation.

Potential organisational approaches for workers undertaking night or shift work may include reducing excessive consecutive night shifts and ensuring adequate recovery periods, particularly among workers with established cardiovascular disease. These approaches should be evaluated prospectively because the included studies did not directly assess the effectiveness of schedule modification.

Occupational-health programmes should also recognise the importance of employment security and sustainable return to work after AMI. Clinical and workplace interventions should address not only whether a patient returns to employment but also whether continued employment is safe, stable, and compatible with long-term secondary prevention. Coordination among cardiology services, cardiac rehabilitation teams, occupational physicians, employers, and workers may help reduce premature labour-market exit and improve adherence to preventive care.

Future research should prioritise repeated individual-level exposure assessment, time-varying employment histories, standardised AMI definitions, and improved adjustment for correlated workplace and conventional cardiovascular risk factors. Sex-specific analyses are also needed, particularly for occupational chemical and particulate exposures. Greater geographical diversity is essential because most incidence studies in this review originated from Nordic countries with comprehensive national registers and comparatively strong occupational regulation. Evidence from informal employment, lower-income settings, and labour markets with weaker exposure controls remains limited.

Strengths and Limitations of the Review

A strength of this review is the structured comparison of diverse occupational domains within a clearly defined core evidence set. The included studies were predominantly large longitudinal cohorts and provided quantitative estimates of association. The review also distinguished incident AMI from composite coronary outcomes and post-AMI prognosis, thereby avoiding inappropriate equivalence between different endpoints. Methodological quality was examined using a structured JBI appraisal, and the interpretation incorporated exposure misclassification, residual confounding, outcome specificity, and the healthy worker survivor effect.

Several limitations should be acknowledged. First, the review was based on a focused PubMed search developed around the occupational domains represented by eight initially identified studies. It was not intended to provide a comprehensive systematic search of all occupational determinants of AMI. Relevant studies concerning psychosocial stress, long working hours, job insecurity, workplace noise, heat exposure, and other occupational hazards may therefore not have been included in the core synthesis.

Second, the search was restricted to English-language, full-text publications indexed in a single database, introducing the possibility of language, availability, and database-selection bias. Third, the small number of studies and substantial heterogeneity in exposure definitions, comparator groups, populations, covariate adjustment, and cardiovascular outcomes precluded meta-analysis. Fourth, most studies of incident AMI were conducted in high-income Nordic countries, which may limit generalisability to other occupational and regulatory settings.

Finally, all included studies were observational and therefore cannot establish causality. The reported associations may have been influenced by residual confounding, exposure misclassification, occupational selection, and changes in employment over time. Nevertheless, the consistency of the findings for diesel engine exhaust, the presence of biologically plausible pathways, and the complementary evidence across occupational domains indicate that workplace conditions should be considered within broader cardiovascular-prevention strategies.

CONCLUSION

This structured narrative review indicates that occupational factors may be relevant across different stages of the AMI-related cardiovascular disease continuum. Among the exposure domains examined, occupational diesel engine exhaust demonstrated the most consistent positive association with incident AMI. Evidence concerning respirable crystalline silica or quartz was heterogeneous, while associations involving night work, travelling work, and other non-standard work schedules were generally modest or confined to susceptible subgroups. Occupational physical activity was not consistently associated with AMI in the overall working population. Employment instability was primarily associated with poorer post-AMI prognosis rather than with the occurrence of a first AMI.

The findings should be interpreted cautiously because the included studies differed in exposure assessment, population characteristics, covariate adjustment, and outcome definition. Exposure misclassification, residual confounding, occupational selection, and the healthy worker survivor effect may also have influenced the reported estimates. Nevertheless, the available evidence supports the inclusion of cardiovascular outcomes in occupational risk assessment and prevention. Future studies should use repeated individual-level exposure measurements, time-varying occupational histories, standardised AMI definitions, sex-specific analyses, and more geographically diverse working populations. Research should also evaluate whether workplace exposure reduction, improved work-schedule organisation, and employment-focused rehabilitation can reduce incident coronary events and improve recovery following AMI.

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