

Common predictors of return to work across cardiovascular diseases

Ellen Tisseghem ^{1,2,*}, Zoë Vandamme^{1,2}, Elvi Lemmens³, Helena Van Deynse ^{1,2}, Kurt Barbé ¹, Pieter Cornu ¹, Johan De Sutter ^{4,5}, Lode Godderis ^{6,7}, and Koen Putman ^{1,2}

¹Research Centre for Digital Medicine, Vrije Universiteit Brussel, Laarbeeklaan 103 1090 Jette, Brussels, Belgium; ²Interuniversity Centre of Health Economics Research, Vrije Universiteit Brussel, Laarbeeklaan 103 1090 Jette, Brussels, Belgium; ³FRAME and Rehabilitation Department, Jessa Hospital, Hasselt, Belgium; ⁴Academy for Rehabilitation Science, Ghent University, Ghent, Belgium; ⁵Department of Internal Medicine and Paediatrics, Ghent University, Ghent, Belgium; ⁶Centre for Environment and Health, KU Leuven, Leuven, Belgium; and ⁷IDEWE, External Service for Prevention and Protection at Work, Heverlee, Belgium

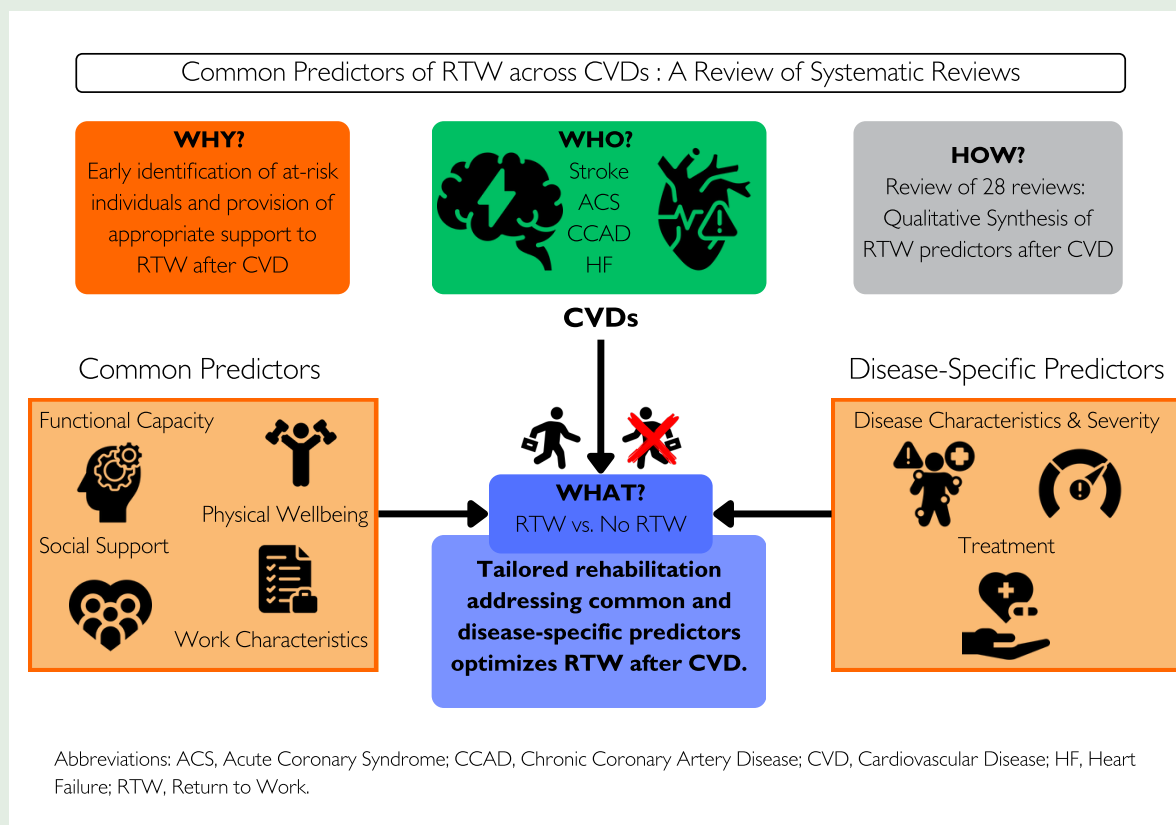
Received 18 February 2025; revised 15 July 2025; accepted 1 August 2025; online publish-ahead-of-print 15 August 2025

Return to work (RTW) after cardiovascular diseases (CVDs) is crucial to mitigating the societal and economic burden of productivity losses. This review of reviews explores common and disease-specific predictors of RTW within the framework of the International Classification of Functioning, Disability, and Health (ICF). A systematic review of systematic reviews was conducted to identify both common and disease-specific predictors of RTW for individuals with cardiovascular diseases (CVDs), including acute coronary syndrome (ACS), chronic coronary artery disease (CCAD), heart failure (HF), and stroke. Predictors were analysed across contextual domains (personal and environmental factors) and functional domains (body structure, body function, activities, and participation). The methodological quality of the included reviews was evaluated using the AMSTAR-2 tool. A total of 28 reviews were included. Key common predictors included functional capacity, psychological well-being, work characteristics, and social support, while disease-specific predictors involved the severity of disease and treatment characteristics. Modifiable factors, such as workplace accommodation and psychological challenges, were identified as critical targets for intervention. Early identification of at-risk individuals and the integration of personalized rehabilitation strategies are critical for improving RTW outcomes and health-related quality of life. This review enhances the understanding of RTW predictors, contributing to optimized rehabilitation processes and reduced economic burden associated with CVDs. Future research should investigate the clinical applicability of these findings and explore the broader application of these common RTW predictors across other chronic conditions, to inform vocational reintegration strategies.

* Corresponding author. Tel: +3224774720, Email: ellen.tisseghem@vub.be

© The Author(s) 2025. Published by Oxford University Press on behalf of the European Society of Cardiology. All rights reserved. For commercial re-use, please contact reprints@oup.com for reprints and translation rights for reprints. All other permissions can be obtained through our RightsLink service via the Permissions link on the article page on our site—for further information please contact journals.permissions@oup.com.

Graphical Abstract



Keywords

Return to work • Cardiovascular disease • Stroke/cerebrovascular disease • Predictors

Introduction

Cardiovascular diseases (CVDs) are defined by the World Health Organization (WHO)¹ as a group of disorders affecting the heart and blood vessels, with coronary heart disease, stroke, and thrombosis being among the most common diagnoses. In 2021, there were an estimated 612 million CVD cases and 19.4 million deaths resulting from CVDs, which was equivalent to 28.6% of all global deaths.² Although the Global Burden of Disease study^{2,3} forecast a decline in mortality rate of CVDs due to overall advancements in treatment, improvement in the level of care and control of cardiometabolic risks (such as smoking, hypertension, and overweight), the global CVD burden is still expected to rise in the next few decades.^{1,4}

The annual cost of CVDs to the EU economy is estimated at €281 billion, of which €155 billion (55%) is attributable to healthcare expenses, €79 billion (28%) to informal care, and €47 billion (17%) to productivity losses caused by absenteeism and reduced workforce participation.⁵ These productivity losses, reflected in 276 working days lost per 1000 citizens due to CVD-related morbidity (€15 billion) and 2.8 years of working life lost per 1000 citizens to CVD-related mortality (€32 billion), emphasize the scale of this economic burden.⁵

The burden of cardiovascular diseases (CVDs) is increasingly reflected in a shift from years of life lost (YLLs) to years lived with disability (YLDs), which means that individuals are expected to live longer but with more years of their lives spent with impairments.³ CVDs cause significant morbidity and lead to a variety of impairments, depending on

the type and severity of the condition, the organ systems affected, and the outcomes of medical interventions. Patients with CVD face a substantially higher risk of living with permanent physical, cognitive, psychological, sensory, and/or functional disabilities, causing challenges for activities of daily living.⁶ Moreover, disabilities resulting from CVDs bear considerable negative consequences for individual health-related quality of life (HRQoL), decreasing labour productivity, and increasing the economic burden.⁷

Return-to-work (RTW) programmes have emerged as a critical strategy to mitigate this burden.⁸ Early RTW is positively associated with better clinical outcomes, enhanced psychosocial well-being, and reduced disability-related costs, highlighting its role as a key component of post-recovery care.⁹ However, to design effective RTW programmes, it is crucial to understand the specific factors that act as barriers or facilitators to a successful RTW after CVD.^{8,10} Identifying these determinants is essential for developing targeted interventions that can address the diverse needs of CVD survivors, ultimately optimizing their functional recovery and enhancing their HRQoL.^{9,11} As such, a comprehensive understanding of the predictors of RTW after CVD is necessary to guide both clinical and policy interventions, ensuring tailored RTW programmes which are more likely to succeed in reducing the long-term economic and health impacts of CVD.

Current literature reveals a vast amount of research exploring predictors, facilitators, and barriers for RTW after CVDs. However, most systematic reviews focus narrowly on specific CVD subtypes, such as stroke, myocardial infarction, or coronary heart disease.

While these reviews provide valuable insights, they also highlight recurring themes, including medical, psychosocial, and work-related factors, suggesting the presence of common predictors across CVD subtypes.^{10,12} Goorts et al.¹³ provide compelling evidence that diagnosis alone, based on the International Classification of Diseases (ICD-10) coding, is less predictive of long-term sick leave risk than a set of psychosocial determinants. This finding underscores the importance of considering factors beyond specific diagnoses when assessing RTW outcomes. Despite this, a comprehensive synthesis of predictors applicable across CVDs is notably absent.

To address this gap, our study aims to consolidate existing evidence into a unified overview of predictors across all CVDs. By identifying common and unique predictors, we seek to establish a holistic framework for RTW strategies that balance cross-disease and disease-specific approaches. This effort lays the groundwork for tailored interventions that optimize RTW success, benefiting a broad range of CVD survivors and alleviating the economic and societal burden of CVDs. The urgency of this work is amplified by global trends, including aging populations, increased retirement ages, and a persistent incidence of CVD among working-age groups, which collectively threaten to escalate the economic impact of CVDs in the coming decades.^{2,7,8} Thus, identifying common RTW predictors represents a critical step towards developing sustainable, effective RTW programmes that respond to these emerging challenges.

Methods

We conducted a systematic review of reviews following the PRISMA guidelines.¹⁴ The study protocol was pre-registered in PROSPERO (CRD42023469107) on 30 November 2023. We opted for a review of reviews method to systematically search, identify, and re-analyse outcomes of a large number of reviews, ensuring a comprehensive synthesis of evidence on key factors affecting RTW after CVDs. It is important to note that this approach is distinct from a meta-analysis. While the latter involves statistical pooling of effect sizes from individual primary studies, our method relies on narrative and thematic synthesis of the findings from existing systematic reviews, some of which may themselves include meta-analyses. This allows for broader integration of heterogeneous evidence without re-analyzing primary-level data.

Definition of terms

In this review of reviews, we aim to identify (common) predictors of RTW after CVDs. Based on the comprehensive definition of CVD by WHO, the following sub-diagnosis were considered for review: Acute Coronary Syndrome (ACS) (including myocardial infarction and unstable angina), Chronic Coronary Artery Disease (CCAD) (including ischaemic heart disease and stable angina), Heart Failure (HF) and Stroke (including ischaemic & haemorrhagic stroke). This approach enables to explore whether there are common predictors of RTW across CVD diagnoses. Predictors encompass both quantitative evidence, referred to as 'factors' in meta-analysis, and qualitative evidence, described as 'facilitators & barriers' in meta-synthesis, which are associated with RTW after CVD but do not necessarily imply causation. In this context, RTW refers to a return to paid employment, either through full or partial reintegration into a previous job, reintegration into the previous job with modifications, or a new job.

Identification of relevant studies

In October 2023, the electronic databases PubMed (Medline & PreMedline), Embase, Scopus, Web Of Science, PsychInfo, and Econlit were searched using the keywords 'Predictor' 'Return to work', and 'Cardiovascular diseases'. The complete search algorithms for each database are available in [Supplementary material online, table S1](#).

Study selection and definition of eligibility criteria

Search results were entered into the reference management software EndNote¹⁵ and then uploaded to Rayyan,¹⁶ a tool for systematic literature reviews. Two independent researchers [E.T. and (E.L. or Z.V.)] selected the suitable reviews for the overview through a multi-step approach: first, eligibility screening based on title and abstract of the review, and a second screening based on full text. Disagreements between these two researchers were resolved by consulting a third researcher (Z.V. or E.L.). The study screening and selection process is shown in [Figure 1](#).

A priori, systematic reviews with or without meta-analysis that investigated predictors of RTW after a cardiovascular event among a labour active population aged 18 to 65 years, were included. No limitations were imposed on types of primary studies included by the review, the year of publication, or the geographic location of the reviews. However, within the included reviews, only results from primary studies assessing CVDs were considered. Review articles that were not published in English, French, German, or Dutch, were excluded. Additional inclusion criteria (reviews that assessed treatment effectiveness in terms of RTW rates) and exclusion criteria (Critically low AMSTAR rating) were determined retrospectively based on the evidence emerging from the preliminary search. The final inclusion and exclusion criteria are summarized in [Supplementary material online, table S5](#).

AMSTAR-2: quality assessment

Quality assessment of each systematic review was performed using the AMSTAR-2 tool.¹⁷ The tool consists of a list of 16 items of which 7 are considered 'critical items'. Given the scope of our review, we modified the list of critical items, consisting of item 1 (PICO components), item 5 (data selection in duplicate), item 6 (data extraction in duplicate), and item 8 (detailed description of included studies). AMSTAR-2 ranks the methodological quality of a systematic review as high, moderate, low, or critically low. E.T. independently scored all the articles with Z.V. double-blinded, scoring 10% of the initially included reviews. Interrater reliability was high (85%). The systematic reviews classified as 'critically low' were excluded from our review (see [Supplementary material online, Table S2](#)).

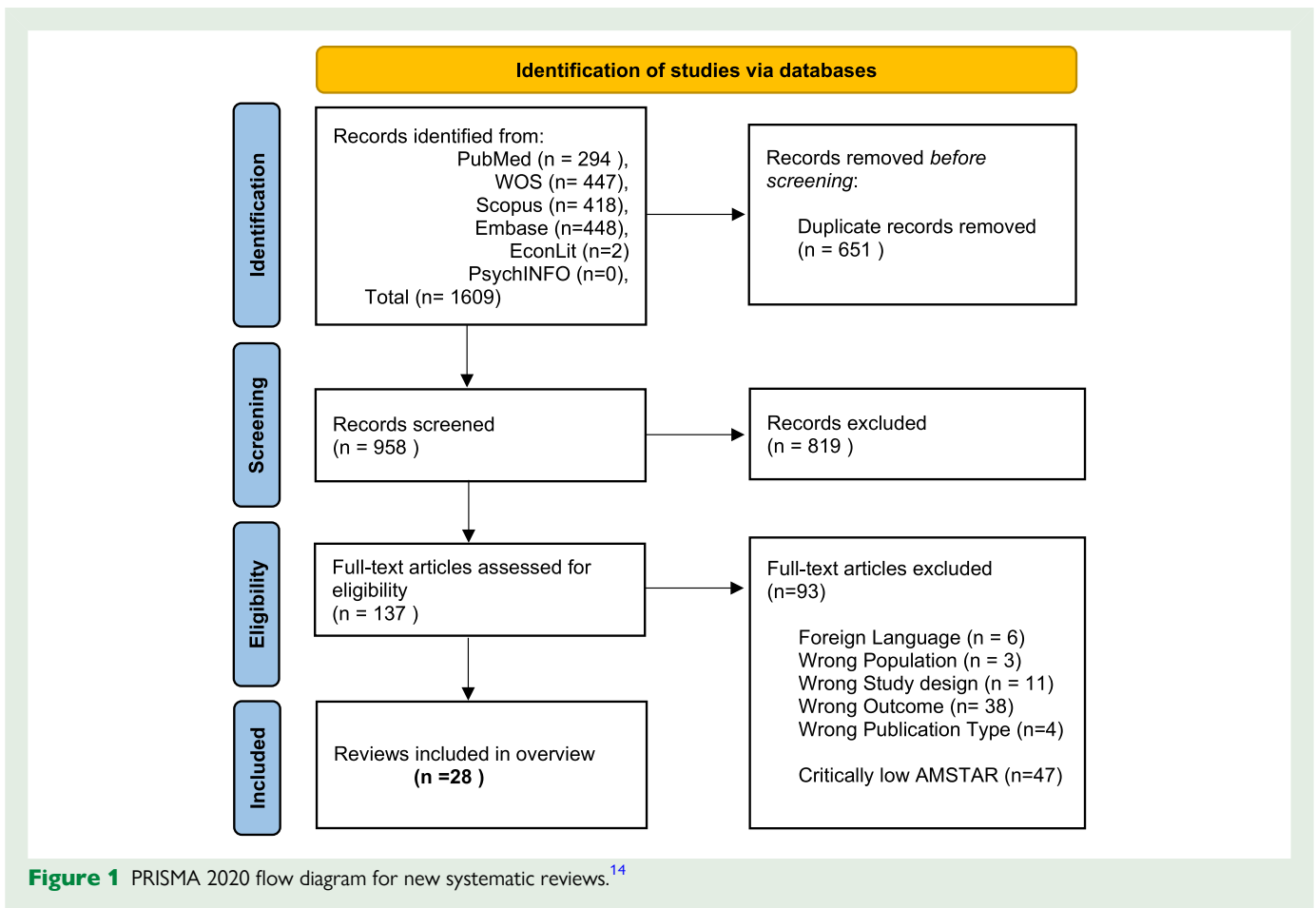
Data extraction

Data extraction was carried out by E.T. using a pre-defined, standardized table constructed in Microsoft Excel¹⁸ to systematically collect and organize relevant information from included studies. This table was developed based on the study objectives and research questions, ensuring consistency in data collection and alignment with the review's aims. Data extraction was piloted on 10% of the included reviews, with E.L. independently extracting data for comparison and discussion. Agreement between reviewers was high, with minor discrepancies in assigned review methodologies (quantitative, qualitative, mixed-method, or best evidence synthesis). These were resolved by defining clear criteria for methodological categorization and applying these criteria uniformly across all included reviews.

From each included review we obtained: (i) metadata (first author and year of publication); (ii) methodological aspects (main method of review, number of (included) primary studies, and included CVDs); (iii) whether RTW predictors was the primary outcome/goal of the review; (iv) predictors investigated (facilitator, barriers); (v) the direction and evidence of association between the predictors and RTW (meta-analytical results if available); factors with no association (or insufficient evidence of association) with RTW (see [Supplementary material online, Table S3](#)).

Data analysis & presentation

The included reviews showed significant heterogeneity in CVD diagnosis, RTW operationalization, and type of analysis (qualitative and quantitative). Therefore, we opted for a qualitative synthesis to answer our research question: *what are the common- and diagnosis-specific predictors for RTW after CVD?* We did not conduct a meta-analysis, but when available and reliable,



we reported adjusted hazard ratios, odds ratios, or proportions related to RTW. In cases where multiple reviews addressed the same predictor, we prioritized findings from the highest-quality reviews based on AMSTAR-2 scores. In cases of substantial heterogeneity or inconsistent pooled estimates, we relied on qualitative interpretation to avoid overinterpreting ambiguous data.

The extracted data were uploaded to NVivo to code the review-findings by conceptual categories, by direction of association with RTW, and by review method. In general, conceptual categories are generated top-down (based on existing theory) or bottom-up (based on data). For this review of reviews, we applied a third, middle-ground approach to generate the coding categories based on concepts of the International Classification of Functioning, Disability and Health (ICF) framework.¹⁹ The ICF is a model of functioning and disability with a biopsychosocial approach, and has been previously used to examine RTW factors across different health conditions. The ICF is structured into components of human functioning and disability; Body structure and Function (e.g. disease/injury-related factors), Activity (Limitations) and Participation (Restriction), and contextual factors; Environmental and Personal factors. E.T. developed the coding system, which was independently reviewed and refined by a second researcher, K.P. Discrepancies were resolved through consensus. In developing the coding system, effort was made to ensure that the subcategories would meet two major requirements: (i) the researchers would preferably/if possible use subcategories already identified in the ICF; (ii) for the personal and environmental factors, the researchers selected (mutually exclusive and exhaustive) subcategories based on the elaboration of the contextual factors of the ICF model for occupational health care by Heerkens.²⁰

Finally, we compiled an overview of predictors, categorized following the ICF framework & elaborations by Heerkens²⁰ in Table 2. For each

predictor, the tables display the original concepts of the included reviews that were positively, negatively or not associated with RTW. The table also indicates the specific CVD diagnoses for which each predictor was identified, along with the corresponding reviews. Additionally, it shows whether meta-analytical evidence exists for a given predictor and references the corresponding meta-analysis. This structured presentation provides a comprehensive synthesis of the available evidence and allows us to identify common and disease-specific predictors for RTW after CVD.

Results

Study inclusion

The study selection process followed the PRISMA 2020 guidelines,¹⁴ as depicted in Figure 1.

Characteristics of included studies

The data-extraction table of the 28 included reviews can be found in [Supplementary material online, Table S3](#). The included reviews are heterogeneous with regards to the primary outcome of interest (factors related to RTW or Other), RTW-operationalization (time-to-RTW, RTW-rates), assessed CVD diagnosis (ACS, CCAD, HF, and stroke), and their study methods. Predictors after stroke were evaluated in 16 reviews, while 12 reviews focused on ACS (primarily myocardial infarction), 9 reviews on CCAD, and 5 reviews on HF. Of the included reviews, 11 employed a qualitative method, 8 used a quantitative approach (meta-analysis), 5 studies applied a mixed-methods design,

and 4 reviews conducted a best evidence synthesis. AMSTAR-2 quality ratings indicated that 10 reviews scored low, 16 scored moderate, and 2 scored high (see [Supplementary material online, Table S2](#)).

Review findings

A large number of factors, facilitators, and barriers for RTW after CVD were identified and classified using the ICF framework.^{19,20} A summary of these predictors is available in [Tables 1a–1c](#).

Personal factors

Sociodemographic factors such as age, gender, education level, ethnicity, and socio-economic status (SES) show varying associations with RTW outcomes after CVDs. For all included diagnoses, younger individuals were more likely to return to work (OR, 1.22; 95% CI [1.10–1.34]),²⁷ leading to shorter periods of sickness absence, while older individuals are absent less frequently but for longer durations.^{12,21–31} However, in a few reviews, no significant association between age and RTW was found.^{32,33} Males generally have better RTW rates [(OR, 1.26; 95% CI, 1.14–1.40; $I^2=48\%$),³⁴ particularly for ACS, CCAD, and stroke.^{21–26,30,34} However, for HF, evidence is sparse, with only one review identifying male gender as a facilitator for RTW.²⁴ Evidence on female gender being a barrier to RTW is inconsistent, with an equal number of reviews reporting an association,^{21,26,28} as those finding no association.^{32,33,35} Higher education was generally associated with better RTW,^{12,21,23,24,26,27,31} but some reviews did not find a significant link between pre-injury education and RTW.^{23,33} Individuals with higher SES consistently showed better RTW outcomes across the reviewed CVDs.^{21–26,30,31,36,37} Ethnicity was less frequently reported, but evidence suggests that white individuals and those born in their country of residence had better RTW rates post-stroke.^{21,23,30} Geographic location or region, on the other hand, was not linked to RTW outcomes in ACS and CCAD.³²

General mental personal factors, such as coping styles and individuals' perceptions of health, show an association with RTW mainly in the reviews assessing ACS or stroke. Individuals with effective coping mechanisms—such as adaptation skills, resilience, creativity, and willingness to seek support, effective stress management and acceptance of limitations—exhibited better RTW outcomes after CVDs.^{12,21,23,26,36,37} In contrast, poor coping skills, reluctance to ask for help, and struggles with maintaining identity are negatively associated with RTW.^{12,21,36,38} Health perception and self-rated QoL were less frequently reported but showed a strong link with RTW, particularly for ACS and stroke. Those perceiving less disability were over three times more likely to RTW (OR, 3.02; 95% CI: 2.48–3.57)²⁷ at 12 months.^{21,24,26,27} Stroke survivors with extensive knowledge about their condition and acceptance of related impairments were also more likely to RTW.^{12,21,23,30} Similarly, a high score on the mental health domain of SF-36 (36-Item Short Form Health Survey) was also found to be associated with a greater chance to RTW after HF.³¹ For CCAD, evidence linking these general mental personal factors to RTW outcomes remains limited.^{24,36}

Personal, disease-related factors and absence of comorbidities, in particular, contribute to successful RTW. People who experience fewer comorbidities, absence of medical complications (see also 'function and structure of the cardiovascular system' in Body structures & Functions), and absence of psychological disorders showed better RTW outcomes across all CVDs,^{12,21,25,26,29,30,34,37} compared to people with more comorbidities, ongoing health issues, and mood disorders.^{12,21,23,24,26–28,30,34,35,39,40} Particularly the presence of depression

is a significant predictor of RTW. One review²⁷ highlighted a clear severity-response relationship: as the severity of depression increases, the likelihood of a successful RTW at 6 months diminishes (moderate depression; aHR, 0.47; 95% CI: 0.31–0.72; severe depression; aHR 0.37, 95% CI [0.21–0.66]).²⁷ For other mood and psychological issues, such as anxiety and stress, and the presence of general cardiovascular risk factors, the evidence concerning RTW outcomes is less conclusive.^{28,35}

In line with the finding that general CVD risk factors do not consistently predict RTW, only two reviews^{26,30} (focused on stroke and ACS), specifically examined *lifestyle factors* as predictors of RTW. A lower alcohol intake before stroke and higher daily step counts were associated with a greater likelihood of RTW, whereas smoking and a sedentary lifestyle were identified as barriers.^{26,30}

In the context of *work-related personal factors*, we found strong evidence supporting work attitudes, beliefs, motivation, and self-efficacy as important predictors of RTW after ACS and stroke. However, for CCAD and HF, the evidence on these factors is limited.^{24,36} Individuals with high job satisfaction, a positive work attitude, and strong motivation to RTW demonstrate significantly better vocational outcomes.^{12,21,23,24,26,30,37,38} These individuals strongly identify with their work and experience a sense of job security, which facilitates a smoother transition back to the workforce.^{12,24} In contrast, financial disincentives (e.g. fear of losing financial benefits), work-related stress, and weak job identification were barriers.^{12,21,26,37} Self-efficacy emerged as a critical factor. Those confident in their ability to RTW, are over eight times more likely (OR 8.5, 95% CI [2.3–32.0])²⁷ to re-integrate into the workforce at 12 months^{12,21,23–25,27,30,37,38} while individuals with uncertainty, negative expectations, and hesitation about RTW were less likely to RTW.^{12,21,38}

Environmental factors

Limited evidence suggests that *the natural environment*, referring to the physical surroundings such as climate, landscapes and outdoors accessibility, may influence the success of RTW after a stroke. While a familiar and accessible environment can provide comfort,³⁸ adverse conditions like bad weather or difficulties related to wheelchair access, can act as barrier to RTW.³⁰ However, the actual value of a familiar environment, and the role that accessibility and availability of physical resources play in successful RTW, remains unclear due to a lack of evidence supporting these non-modifiable factors.³⁸

The *work-related environment* plays a critical role in RTW. Factors such as the task content, terms of employment, characteristics of the employment organization, the professional support provided by the organization, social relationships at work, and the actual labour services, systems, and policies can both positively and negatively impact vocational reintegration. Over all included CVDs, white-collar workers (white collar; 81.2% RTW, 95% CI [64.5–93.6], $I^2 = 96\%$; blue collar; 65.0% RTW, 95% CI [39.7–86.7], $I^2 = 97\%$)³² with lower job demands, high job control, and job satisfaction generally have better RTW likelihood.^{12,21,22,24–27,32,34–36,39,41} There is some evidence on association between characteristics of the employment organization and RTW, where individuals working in larger enterprises with a better accessibility to transport services and equipment show better vocational outcomes, but this was only apparent in reviews on stroke.^{21,23,30,37,38,41} Furthermore, a flexible workplace with opportunities for gradual RTW and adaptations in the work environment is also linked to better vocational outcomes compared to less flexible and unfavourable terms of employment.^{12,21,26,30,36–38,42} However, for people with CCAD,

Table 1a Overview of predictors of RTW after CVD following the ICF framework; personal factors

ICF Domain	Category of predictor	Predictors	Positive association with RTW	Negative association with RTW	No association with RTW	CVD Diagnosis
Personal factors	Sociodemographic factors	Age	Young age* ^{12,21–26} (*27)	Old age ^{12,26,28–31}	(Old) age ^{32,33}	ACS, CCAD, HF, Stroke
		Gender	Male* ^{21–23,25,26,30} (*34) [24]	Female ^{21,26,28}	(Female)gender ^{32,33,35}	ACS, CCAD, [HF], Stroke
		Education level	High education level ^{12,21,23,24,26,27,31}	Low education level* ^{12,21,23,26,30} (*32)	Pre-injury education level ^{23,33}	ACS, CCAD, HF, Stroke
		Ethnicity	White; Being born in country of residence; Non-black individual ^{21,30}	Non-White; Not being born in country of residence; Affiliation with minority group ^{21,23}	Region ^[32]	[ACS, CCAD], Stroke
	SES	High SES/income; Financial concern/stress; Economic stability; Northern and rural region of origin; Married/in relationship ^{21–26,30,31,36,37}	Low SES/income; Financial stress ^{21,26,37}		ACS, CCAD, HF, Stroke	
General 'mental' personal factors/psychological assets	Coping styles:	Adaptions skills and resilience (to cope with cognitive impairments); Desire to enhance well-being (overcoming stress, reinforcing self-confidence & feeling good); creativity & taking initiative; Practical & spiritual coping strategies; Willingness to seek support; Personality type ^{12,21,23,26,27,37} [36]	Absence of coping and adaptation skills; Fear of asking help & sharing problems when applying for job; lack of acceptance/awareness/willingness to seek support; anxiety/worries/fear/insecurity; Struggles with maintaining identity ^{12,21,38} [36]		ACS,[CCAD, HF],Stroke	
	Perceived health:	High self-rating of health* and quality of life; Lower self-rating of impairment, High score on mental health domain of SF-36 ^{26,31} (*27) [21]	Low self-rating of health & quality of life; Health concerns; Reappraisal of work-life balance/other priorities, ²⁷ [21,24]		ACS, [CCAD], HF, [Stroke]	
	Health literacy:	Stroke-specific knowledge, Acceptance (& insight) of impairments, understanding the injury ^{12,21,23,30}	No stroke-specific knowledge, no acceptance of impairments ¹²		Stroke	
Disease-related factors	Comorbidities	Less comorbidities; Absence of post-stroke medical complications; No diabetes; Fewer comorbid disease risk factors; No psychological disorders/psychological well-being; No depression*, Less anxiety(attacks) ^{12,21,25,26,29,30,37} (*34)	More comorbidities; Post-stroke medical complications; Ongoing medical/health problems; Significant comorbidities (e.g. diabetes, chronic obstructive pulmonary disease, renal failure, dyspnoea, atrial fibrillation, cerebral vascular diseases, hypertension); Mood disorders; Depression* (pre-& post-surgery); Anxiety; Mental breakdown, ^{12,21,23,24,26–28,30,35,39} (*34,40)	Anxiety ^{28,35} Stress ²⁸ CVD risk factors ³⁵	ACS, CCAD, HF, Stroke	

Continued

Continued

Table 1a Continued

ICF Domain	Category of predictor	Predictors	Positive association with RTW	Negative association with RTW	No association with RTW	CVD Diagnosis
Lifestyle	Work-related personal factors	Work attitudes, beliefs & motivation	Low alcohol intake prior to stroke; More daily steps; [26,30]	Smoking; Sedentary life [26]		[ACS, Stroke] ACS, [CCAD, HF], Stroke
			High motivation to RTW; Financial incentives to RTW; Guilt/fear if no RTW soon; Positive attitude towards work; high job satisfaction; Individual beliefs & priorities; Strong work identification & significance. Feeling of job-security; [12,21,23,24,26,30,37,38]	Low motivation to RTW; Negative feelings towards work; Financial incentives not to RTW; Low/moderate job satisfaction; Work-related stress; Fear of losing financial benefits when (full-time) RTW, Weak work identification & significance; [12,21,26,37 [36]		
		Self-efficacy related to/in RTW:	Patient perception of work*/ability/readiness to RTW; Self-assessed work capacity*; Knowledge & confidence to access RTW support; Control over decision-making regarding RTW; Positive attitude & realistic expectations regarding RTW; Self-confidence in ability to meet job demands [12,21,23,26,37,38] (#27) [24]	Uncertainty about recovery; Anxiety/reduced confidence; Hesitation about RTW; Negative attitudes & too high expectations of RTW [12,21,23,38]		ACS, [CCAD, HF], Stroke

ACS, acute coronary syndrome; ADL, activities of daily living; CABG, coronary artery bypass grafting; CCAD, chronic coronary artery disease; CI, confidence interval; CR, cardiac rehabilitation; HCR, hybrid coronary revascularization; HF, heart failure; ICD, International Classification of Functioning, Disability and Health; IVT, intravenous thrombolysis; LoS, length of stay; MI, myocardial infarction; m, months; NIHSS, National Institutes of Health Stroke Scale; OH, occupational health; OR, odds ratio; PCI, percutaneous coronary intervention; PCTA, percutaneous transluminal coronary angioplasty; p, probability; RR, relative risk; RTW, return to work; SES, socio-economic status; VR, vocational rehabilitation; vs., versus.

Legend: X* = Quantitative study (meta-analysis); [] = If a predictor is identified in only one review for a specific diagnosis; No association (regular) = Evidence of no association; No association (italic) = Insufficient evidence of association.

Table 1b Overview of predictors of RTW after CVD following the ICF-framework; environmental factors

ICF domain	Category of predictor	Predictors	Positive association with RTW	Negative association with RTW	No association with RTW	CVD diagnosis
Environmental factors	Natural environment		Familiar environment ³⁸	Inconvenient environmental conditions (wheelchair & bad weather) ³⁰	Environmental obligations and opportunities, Physical environment, accessibility, physical resources, value of familiar environment ³⁸	Stroke
	Work-related environment	Task content:	White collar*: Business; Professional/Skilled labour; Managerial roles; Self-employed; Non-manual work; Job control (autonomy & decision latitude); Reduced working hours; Less physical*, mental and psychosocial job demands/workload ^{12,21,22,24-27,36,39,41} (#32,34,35)	Blue collar: Manual work; Non-manager; Agricultural workers; Physical, mental & psychosocial demanding jobs; Low job control & high workload/job strain; Inability to meet job demands ^{12,21,22,26-28,30,36,39,41}		ACS, CCAD, HF, Stroke
		Terms of employment	Workplace flexibility & accommodations; adaptations in physical work environment; Flexible working arrangements; Phased/gradual return to work with reduced hours and lighter duties; Work trials; Possibility for job adaptation or replacement; High salary jobs ^{12,21,26,30,37,38,42} [36]	Limited flexibility & adjustments in work environment; Reduced possibility of promotion/job change; Difficulties applying for new job due to limited flexibility; Low salary job; Job loss; Unfavourable terms of employment ^{12,21,26} [36]	Availability of a flexible work schedule, working fewer hours or changing work tasks ⁴⁰ (CCAD) Re-engagement as an iterative process ³⁸	ACS, [CCAD, HF], Stroke
		Characteristics of employment organization	Large enterprise size; Availability of transport services, (Personal adapted) equipment & accessible environment ^{24,25,30,37,38,41}	Small enterprise size; Less accessible environment; Need for long-distance mobility; Limited access to transportation and equipment ^{21,30}		Stroke
		Professional support provided by organization:	Availability of OH services & Disability management practices; Early involvement (& support) of an occupational physician; employer and individual; Interventions personalized to the individuals functional abilities and workplace challenges, including work-directed interventions and skills training (e.g. work skills, social skills, coping, emotional support, education/coaching); Access to resources for support and education/concrete information; counselling and support provided by stroke specialists to employers; a support person to aid employer negotiations, Union support ^{12,21,30,37,41,42} [36]	No availability of OH services & No disability management practices; Insufficient support from occupational health service, human resources, employment services; High demands on employer of supporting RTW; Lack of support provided to employer; Problems with financing support & accommodations at workplace ^{12,21,30}	Effectiveness of skills training, cognitive rehabilitation programme, supported employment services ⁴² Person-directed interventions; psychological interventions, health education programmes, work-directed counselling, exercise programmes alone ⁴³ (ACS,CCAD)[Evidence for potential of combined interventions]	ACS, CCAD, [HF], Stroke
		Social relation-ships at work	Social network at work, Support from colleagues and employer; occupational health staff, human resources, employment services, managers and supervisors. Communication/ openness between individual, employer and health professional; Positive relationship with employer pre-stroke; Employer knowledge of RTW responsibilities ^{12,21,27,30,37-39} [36]	Insufficient support from colleagues & employer; Unfamiliarity of employer; Negative attitude of employer (uncertainty, wanting individual to leave); Negative relationship with employer pre-stroke; Mismatch between employer, colleagues & individuals perception of abilities; Discrimination; Limited employer knowledge of RTW responsibilities & awareness of stroke-related problems ^{12,21,30,36}		ACS, [CCAD, HF], Stroke
	Labour & employment services, systems and policies		Favourable situational labour market factors, Sickness, pension, unemployment insurance system, labour and disability legislation; rights and duties of employers and individuals	Unfavourable situational labour market factors; Sickness, pension, unemployment insurance system, labour and disability legislation; rights and duties of employers and individuals; Country/geographic location; Insufficient		[HF], Stroke

Continued

Table 1b Continued

ICF domain	Category of predictor	Predictors	Positive association with RTW	Negative association with RTW	No association with RTW	CVD diagnosis
Healthcare-related environment		Healthcare services systems and policies	Individuals; Country/geographic location; Funding of health care and VR service; Government initiatives ^{12,23} [31]	funding of health care and VR service; Lack of government initiatives ¹² [31]		ACS, [CCAD], HF, Stroke
			Adequate stroke-specific information policy; Healthcare system delay ≤120 min (time from the first call for emergency service to receiving intervention) ; Short LoS; Quick access to occupational health services after a MI; Individuals with health insurance ^{12,21,23,25,26}	Inadequate stroke-specific information policy; Healthcare system delay >120 min; long time to call emergency service after experience of chest pain; Long LoS; No health insurance; Admission to an unsuitable ward; Misdiagnosis of illness; Complexity of systems and services (eg. interface management; communication, coordination, cooperation) ^{12,21,26,30,37,39} [28]		
		VR services:	Comprehensive multidisciplinary rehabilitation, both general and/or specialist VR; Person-directed & combined (psychological, work directed & physical) interventions with mood & fatigue management; Treatment consisting of (neuro)psychological services, social work, physical therapy, speech therapy, work-directed interventions; Group or individually delivered psychological and vocational counselling*; Stakeholder involvement (including family, employer and co-workers); On the-job training and coaching, (Timely) flexible & detailed RTW assessment (work capacity, -performance & -capability); Adequate rehabilitation plans; Short & less intense rehabilitation; Active discussions with individuals regarding lifestyle and goals after recovery; Quality assurance of VR services ^{12,21,23,28–30,39,41,43,44} (45) [31]	Inadequate rehabilitation (aimed at achieving a minimum functional level which was insufficient for RTW) ; Insufficient knowledge of RTW process; Lack of detailed RTW assessment; Long & intense rehabilitation; Limited involvement of individuals in RTW negotiations; Consent issues; Insufficient duration of VR; No Quality assurance of VR services ^{12,21,28,30,37,39}		ACS, CCAD, [HF], Stroke
			Availability/accessibility/appropriateness of healthcare, rehabilitation, specific VR, VR support, RTW services, education, and information ^{12,21,30}	Lack of availability/accessibility/appropriateness of healthcare, rehabilitation, VR support, RTW services, education, and information. ^{12,21}		
Support & Relationships		Family, friends, peers, personal care providers:	Support from family (and family feeling supported), friends, peers and society; Pressure from social environment to regain pre-stroke activity level; Individuals living with others (e.g. partner, children). Individuals with caregivers who are female/younger/working; Societal awareness & positive societal expectations regarding RTW after stroke ^{12,21,23,26,30,37–39}	Lack of support from family and peers (and family anxiety); social isolation, living alone, individuals with male/old/non-working caregivers, Feeling of being perceived negatively by others; Poor societal awareness & negative societal expectations regarding RTW after stroke ^{12,21,26} [36]		ACS, [CCAD], HF, Stroke

Continued

Table 1b Continued

ICF domain	Category of predictor	Predictors	Positive association with RTW	Negative association with RTW	No association with RTW	CVD diagnosis
		Health professionals:	Support within health and social care systems; Psychological support prior to heart transplantation/surgery; Positive liaison, effective communication, cooperation, collaboration & shared learning between individual, healthcare professionals, VR support, employers and stakeholders; Positive physician perception of disability*; Expertise, positive attitudes and behaviours of health care and rehabilitation professionals; Doctors advice to RTW ^{12,21,26,31,36,37(*,27)}	Lack of support within health- and social care systems, Poor communication, lack of shared plans and contact between healthcare professional, workplace, individual, and relevant stakeholders; Limited support from VR specialists; Negative attitudes and behaviours of healthcare and rehabilitation professionals; Doctors active discouragement of RTW ^{12,21,26,36}		ACS, [CCAD], HF, Stroke

ACS, acute coronary syndrome; ADL, activities of daily living; CABG, coronary artery bypass grafting; CCAD, chronic coronary artery disease; CI, confidence interval; CR, cardiac rehabilitation; HCR, hybrid coronary revascularization; HF, heart failure; ICD, International Classification of Functioning, Disability and Health; IVT, intravenous thrombolysis; LoS, length of stay; MI, myocardial infarction; m, months; NIHSS, National Institutes of Health Stroke Scale; OH, occupational health; OR, odds ratio; PCI, percutaneous coronary intervention; PCTA, percutaneous transluminal coronary angioplasty; p, probability; RR, relative risk; RTW, return to work; SES, socio-economic status; VR, vocational rehabilitation; vs., versus.
Legend: X* = Quantitative study (meta-analysis); [] = If a predictor is identified in only one review for a specific diagnosis; No association (regular) = Evidence of no association; No association (italic) = Insufficient evidence of association.

these flexible working arrangements show no association with RTW.⁴⁰ Unsurprisingly, the professional support provided by the employment company is a significant predictor of RTW after CVDs. When organizations provide occupational health services where all relevant stakeholders (occupational physician, employer & employee) are involved early in the process and interventions are personalized and include skills training (e.g. work skills, social skills, coping, emotional support, and education/coaching), people show better vocational outcomes.^{12,21,30,36,37,41,42} There is currently no evidence supporting the effectiveness of skills training, psychological interventions, or health education as standalone approaches for RTW. However, combined interventions have shown greater potential to improve RTW outcomes.^{42,43} Next to the physical work-environment, the social environment at work or positive relationships, open communication and support from colleagues, employer, Human Resources (HR), occupational health staff, and other actors in the working context, is vital for successful RTW.^{12,21,27,30,36–39} Finally, a few reviews highlight the importance of labour & employment services, systems, and policies in supporting RTW. Favourable labour market factors, including availability of unemployment insurance systems, robust labour and disability legislation, and sufficient funding for healthcare and rehabilitation, help facilitate successful RTW.^{12,23,31} Government initiatives and country-specific factors, like geographic location, also play a role. In contrast, unfavourable labour conditions, such as insufficient funding, unclear legislation, and lack of government support, act as barriers to RTW.^{12,31} These limitations can hinder access to necessary resources for rehabilitation and reintegration.

In the *healthcare-related environment*, existing healthcare services, systems, policies, and vocational rehabilitation (VR) services, play a crucial role in RTW after CVDs. The presence of adequate disease-specific information policies, rapid emergency response times (within 120 min) or time from the first call for emergency service to receiving intervention, shorter length of hospital stays (LoS), and health insurance coverage are related to better RTW outcomes after ACS, HF and stroke.^{12,21,23,25,26} While these elements may not directly impact RTW, they likely reflect the underlying severity of the condition or the efficiency of healthcare delivery. Conversely, issues such as delayed emergency responses, extended LoS, lack of health insurance, and systemic complexities (like misdiagnosis or poor communication) act as barriers to successful reintegration across all included CVD diagnosis.^{12,21,26,28,30,37,39} VR services enhance RTW for all CVDs when it includes a multidisciplinary, personalized approach with combined psychological, work-directed, and physical interventions, stakeholder involvement, on-the-job training, flexible RTW assessments, and quality assurance.^{12,21,23,28–31,39,41,43–45} Both group and individual vocational counselling expedite RTW compared to standard care, with participants returning to work on average 6.11 days earlier than those receiving standard care (95% CI [–6.95—5.26]).⁴⁵ However, barriers such as minimal-function-focused rehabilitation, lack of detailed RTW assessments, overly intense or insufficiently long rehabilitation, limited patient involvement, and missing quality standards hinder RTW success.^{12,21,28,30,37,39} Particularly for stroke patients, accessibility and suitability of healthcare, VR services and RTW resources, improve the likelihood of successful reintegration, while a lack of these resources creates significant barriers.^{12,21,30}

Supportive relationships, both in personal and healthcare contexts, are essential for successful RTW outcomes. For individuals with ACS and stroke, adequate support from family, friends and the community significantly facilitates reintegration, as does societal awareness and positive RTW expectations.^{12,21,23,26,30,37–39} Living with family or

Table 1c Overview of predictors of RTW after CVD following the ICF-framework; body structures & functions, activities & participation

ICF domain	Category of predictor	Predictors	Positive association with RTW	Negative association with RTW	No association with RTW	CVD diagnosis
Body structures & Functions	Function & structure of cardiovascular systems	Characteristics of pathology & severity:	Infarct; Location of MI in anterior heart wall; Right hemisphere stroke; Low severity (NIHSS)*; Lower rates of complications (allograft rejection, infection and fewer orthopaedic and neuromuscular problems) ^{12,21,23,26} (³⁴)	Unspecified aetiology of stroke; Haemorrhagic stroke*; Left hemisphere stroke, High severity (NIHSS) ^{12,21,29,30} (³⁴) [28]	Side of stroke (left-hemisphere stroke), Anatomical location ^{33,34} Location of M] ²⁶	ACS, [CCAD], Stroke
		Heart, blood vessel and blood pressure functions:	High degree of cardiovascular fitness; Normal left ventricular ejection fraction (LVEF $\geq 40\%$); Absence of angina pectoris, HF, atrial fibrillation, Q waves; Normal serum troponin; High levels of serum magnesium at admittance; Normalization of blood pressure before surgery; Shorter extracorporeal pump run time during surgery ^{25,26} [21,24]	Low degree of cardiovascular fitness; Degraded left ventricular ejection fraction*; Longer extracorporeal pump run time during surgery (78.8 min); Recurrent cardiac event; Arrhythmia during admission ²⁷ (³²) [21,24]		ACS, CCAD, [HF, Stroke]
	CVD Treatment:		HCR without conventional sternotomy (Use of minimal invasive techniques in HCR); PCI > CABG > usual care; PCI with drug eluting; Medication; Treatment with IVT > control ^{21,26,28,44,46}		Type of treatment (PCTA vs. CABG) ³² IVT ³⁴	ACS, CCAD, Stroke
		(Cardiac) Rehabilitation:	Shorter length/lesser intensity of rehabilitation; Participation in CR (<1Y & > 1Y)*; Exercise based CR > usual care*; Comprehensive CR = Standard CR = Exercise based CR*; Out-patient CR > In-patient CR ^{24,26,28} (^{35,47})		Duration of CR ³⁵	ACS, CCAD, HF, Stroke
	Sensory & movement-related functions		Low degree of (work)disability (modified Rankin Scale); High degree of functional independence*; Less stroke-related impairments of body structures and functions; Medical stability; Better score on physical domain (SF-36); Higher degree of upper limb and lower limb function; Good balance; Ability to walk; Footsteps per day	High degree of (work)disability (modified Rankin Scale); low working capacity at hospital discharge and after CR; Low degree of functional independence*; Severe stroke-related impairments of body structures and functions & Physical limitation; Invisibility of injury related impairments; Lower degree of upper and lower limb		ACS, CCAD, HF, Stroke

Continued

Table 1c Continued

ICF domain	Category of predictor	Predictors	Positive association with RTW	Negative association with RTW	No association with RTW	CVD diagnosis
Activities & Participation			(high)*; Higher six-minute walk test results; Good somatic health* (fewer somatic complaints); No visual field defect; Less post-CVD fatigue; Less pain/discomfort/chest pain after surgery ^{12,21,22,24,25,30,31,37} (* ²⁷)	function; Communication problems; Poor balance; Less walking; Lower Somatic health; Footsteps per day (low)*; high degree of visual field defects; Post-CVD fatigue; High degree of pain/chest pain during day ^{12,21,23,24,26,29,30,35,36,39} (* ²⁷)		
	Mental function	High cognitive abilities; preserved cognitive function after hospital discharge; No cognitive/executive function impairments; Lower degree of neurological deficit, neuro-disability, spasticity, hemiparesis, apraxia; Absence of communication disorders (aphasia) ^{21,29,30,39}	High degree of cognitive impairments; Higher degree of neuro-disability, spasticity, hemiparesis, communication disorders (aphasia*), personality changes and sleep disturbance ^{21,30,39} (* ³⁴)			Stroke
	General tasks and demands	High Functional independence in ADL*; Markers of independence/return to normality/return to social role; Pre-scheduled activities; ability to manage own finances and to perform activities in private and working life. ^{12,21,23,29,30,33,38,39} (* ³⁴) [³⁶]	Lower modified Barthel index score (low independence in ADL) at follow-up; inability to perform activities in private and working life ^{12,29}			[ACS, CCAD, HF], Stroke
	Mobility	Ability to drive, use public transport, ability to walk ^{21,23,30,33}	No return/ability to drive ²¹			Stroke
	Community, social and civic life	Higher degree of participation; Valued/meaningful activities opportunities (voluntary work, leisure activities); work as a social outlet and opportunity to interact and meet people ^{21,37,38}	Lower degree of participation; Reduced and challenging social integration causing frustration ^{21,37}			Stroke
	Work & Employment	Prior CVD: (Full-time) Employment before/at time of CVD; Less sick leave prior to CVD; ^{12,21,23,29-31} [²⁴]	No employment before/at time of CVD, sick leave prior to CVD, ^{12,23,26,30}	pre-injury employment ²³		ACS, [CCAD], HF, Stroke
Continued						

Table 1c Continued

ICF domain	Category of predictor	Predictors	Positive association with RTW	Negative association with RTW	No association with RTW	CVD diagnosis
		Post CVD:	Early RTW (after 1 year/at discharge/at initial follow-up); Short absence from work (</=3 m)*; Training/work-trial/voluntary work as transition; Positive experience of initial RTW; Involvement in paid work; Changing job ^{12,21,23} [¶27]	Negative experience of initial RTW ^{12,21}		[ACS], Stroke

ACS, acute coronary syndrome; ADL, activities of daily living; CABG, coronary artery bypass grafting; CCAD, chronic coronary artery disease; CI, confidence interval; CR, cardiac rehabilitation; HCR, hybrid coronary revascularization; HF, heart failure; ICD, International Classification of Functioning, Disability and Health; IVT, intravenous thrombolysis; LoS, length of stay; MI, myocardial infarction; m, months; NIHSS, National Institutes of Health Stroke Scale; OH, occupational health; OR, odds ratio; PCI, percutaneous coronary intervention; PCTA, percutaneous transluminal coronary angioplasty; p, probability; RR, relative risk; RTW, return to work; SES, socio-economic status; VR, vocational rehabilitation; vs., versus.
Legend: X* = Quantitative study (meta-analysis); [] = If a predictor is identified in only one review for a specific diagnosis; No association (italic) = Evidence of no association; No association (italic) = Insufficient evidence of association.

having younger, employed, female caregivers aids recovery, while social isolation and relying on male, elderly, or unemployed caregivers presents considerable challenges. Negative societal perceptions and stigma can also hinder RTW efforts.^{12,21,26} In the healthcare setting, effective psychological support, strong collaboration among professionals, and a positive physician outlook on RTW (OR, 1.61; 95% CI [1.16–2.07])²⁷ all promote successful reintegration. Expertise and encouraging attitudes from healthcare providers, along with proactive RTW advice, are particularly beneficial.^{12,21,26,27,31,36,37} Limited healthcare support, poor communication, and discouraging attitudes from healthcare providers hinder the RTW process.^{12,21,26,36}

Body structures and functions

The *function and structure of the cardiovascular system*, disease severity, and comorbidities (see also ‘personal, disease-related factors’ in Personal Factors) are key RTW determinants for ACS (MI) and stroke. Importantly, the nature and severity of disease-related sequelae vary substantially across these conditions, influencing RTW differently. Stroke survivors frequently face persistent physical, cognitive, and communication impairments that can severely limit their ability to return to work, even when motivation is high. Right hemisphere strokes are associated with more favourable vocational outcomes, particularly when severity is low according to the National Institutes of Health Stroke Scale (NIHSS); or each 1-point decrease in NIHSS score, the odds of RTW increased significantly (OR, 1.23; 95% CI [1.08–1.39], *I*²=64%).³⁴ These outcomes are further improved when medical complications (such as infections, allograft rejection) or comorbid orthopaedic and neuromuscular issues—are absent.^{12,21,23,26,34} In contrast, strokes of unspecified aetiology and haemorrhagic strokes, particularly left hemisphere strokes with high severity, pose significant barriers to reintegration.^{12,21,29,30,34} The effect of MI location remains unclear, with some primary studies supporting the idea that patients with anterior heart wall damage are more likely to RTW, while others find no association.²⁶ For all CVDs, heart function, blood pressure, and cardiovascular fitness are critical for RTW. Facilitators include a normal left ventricular ejection fraction (LVEF ≥40%), absence of angina or HF, normal serum troponin levels, and normalized pre-surgery blood pressure.^{21,24–26} Barriers include low cardiovascular fitness, degraded LVEF, prolonged extracorporeal pump run times, and recurrent cardiac events.^{25–27,32} Some interventional strategies, such as Coronary Artery Bypass Grafting (CABG), Percutaneous Coronary Intervention (PCI), and Hybrid Coronary Revascularization (HCR), show promising vocational results in specific contexts. For example, PCI, particularly with drug-eluting stents, has been shown to lead to better RTW rates compared to CABG after a coronary event.^{26,28} However, patients who underwent CABG post-MI were more likely to RTW than those who did not have this surgical procedure.²⁶ Furthermore, use of minimal invasive techniques in HCR—a combination of CABG and PCI, without sternotomy—has been linked to positive vocational outcomes after ACS.⁴⁶ However, findings on the long-term effectiveness of these treatments in promoting RTW are inconsistent, as some studies reported no significant differences based on treatment type.^{32,34} For HF and stroke patients, evidence is limited, with no intervention proven particularly effective in improving RTW outcomes. Multidisciplinary rehabilitation, including physical and vocational components, is a key facilitator of return to work (RTW) across cardiovascular diseases. Cardiac rehabilitation (CR) is especially important for cardiac conditions (ACS, CCAD, HF), promoting functional recovery through exercise and education. Stroke rehabilitation differs,

focusing on neurorehabilitation and often requiring tailored vocational support. Among cardiac patients, exercise-based (65% RTW, 95% CI [41–88]) and comprehensive CR (68% RTW, 95% CI [65–70]) show no major differences in vocational outcomes.³⁵ Findings from high risk of bias trials suggest that exercise-based CR after cardiac surgery may outperform usual care (RR, 0.69; 95% CI [0.50–0.95]), with similar results in observational studies (RR, 0.58; 95% CI [0.46–0.73]).⁴⁷ Additionally, out-patient CR is more effective than in-patient CR, with 72% returning to work (95% CI [62–82] vs. 61.0%, 95% CI [36–86]).^{24,26,28,35,47} Both short-term (<1 year; 69% RTW, 95% CI [62–74], $I^2=80$) and long-term (>1 year; 65% RTW, 95% CI [57–71], $I^2=93$) programmes yielded benefits,³⁵ supporting the finding that the duration of CR does not significantly impact RTW outcomes.

A substantial number of reviews identified *sensory and movement-related function* as a predictor of work resumption. Individuals with high functional independence were over six times more likely to RTW at 12 months (OR, 6.7; 95% CI [1.8–24.5]) and high scores in somatic and physical health metrics (OR, 1.08; 95% CI [1.02–1.14]), such as limb functionality and daily step count (OR, 1.18; 95% CI [1.01–1.38]),²⁷ were linked to higher RTW likelihood at six months,^{12,21,22,24,25,27,30,31,37} In contrast, work disabilities and somatic health issues act as barriers, especially when impairments are less visible.^{12,21,23,24,26,27,29,30,35,36,39}

Individual *mental or cognitive function* was also identified as a factor influencing vocational outcomes, particularly post-stroke. Preserved cognitive functions post-discharge and high cognitive abilities are positively associated with RTW.^{21,29,30,39} On the other hand, extensive cognitive impairments, neurological-disability, -spasticity, hemiparesis, communication difficulties (aphasia; OR 0.37, 95%CI [0.20–0.69], $I^2=77\%$),³⁴ personality changes, and sleep disturbances present major barriers to RTW.^{21,30,34,39}

Activities and participation

Reviews identify *general tasks and demands*, such as activities of daily living (ADL), as critical determinants of RTW, with individuals capable of ADL being four times more likely to return to work (OR, 4.00; 95% CI [1.73–9.23]; $I^2=89\%$).³⁴ When individuals can engage in pre-scheduled tasks, manage finances, and handle essential responsibilities, it aids their transition to employment especially after stroke.^{12,21,23,29,30,33,34,36,38,39} Return to normality after a CVD was identified as an RTW-facilitator for all included diagnosis.³⁶ Conversely, lower ADL scores (Modified Barthel Index) or inability to perform daily activities hinder RTW particularly after stroke.^{12,29}

Concerning *mobility*, reviews on stroke highlight that individuals who can drive, use public transport, and walk independently are more likely to resume work, whereas loss of mobility hinders RTW.^{21,23,30,33}

Community, social, and civic life also influence RTW after stroke. High social participation, including volunteering and leisure activities, enhances RTW potential by helping individuals maintain connections, which boosts motivation.^{21,37,38} However, limited and challenging social reintegration causes frustrations and acts as a barrier to RTW.^{21,37}

Employment and work history are critical predictors of RTW. Full-time employment before the CVD and lower sick leave rates correlate with better RTW outcomes for all included diagnosis.^{12,21,23,24,29–31} In contrast, a history of unemployment or frequent sick leave is associated with lower RTW likelihood, particularly among stroke survivors.^{12,23,26,30} However one review found no association between RTW and pre-injury employment.²³ Finally, post-CVD work engagement also appears to influence long-term RTW, particularly for ACS

and stroke patients. Early re-engagement within the first year, shorter (pre-operative) work absences (≤ 3 months; OR 4.9, 95% CI [1.2–20.2]),²⁷ and positive initial RTW experiences correlate with better vocational outcomes.^{12,21,23,27} However, negative early RTW experiences are linked to poorer long-term results.^{12,21}

Discussion

This review of reviews has synthesized key predictors of RTW for individuals with CVDs, following the ICF framework.^{19,20} A more aggregated overview of these predictors across cardiovascular diagnoses is provided in [Supplementary material online, Table S6](#). The findings suggest that while diagnosis-specific factors do influence RTW outcomes, they are often less critical than broader, non-disease-specific factors.

Common RTW predictors, such as functional capacity, psychological well-being, workplace adaptations, and social support, consistently emerged across various CVD diagnoses. These findings are consistent with the work of Schwarz et al.,¹² who demonstrated that RTW after stroke is largely influenced by generic factors, such as job demands and opportunities for work adaptations, rather than exclusively stroke-specific attributes. Gragnano et al.⁸ and Figueredo et al.⁴⁸ even advocate for a 'cross-disease approach,' emphasizing the importance of shared predictors across different conditions, including mental health disorders, cancer, and CVDs. The findings from Standal et al.⁴⁹ reinforce this perspective, suggesting that individuals on sick leave can often be categorized based on common prognostic factors rather than specific diagnoses.

Despite the prominence of these common predictors, disease-specific factors remain relevant. Our findings suggest that RTW outcomes are influenced by the severity and characteristics of the underlying pathology, as well as the administered treatments. While this review considered cardiovascular diseases as a broad category, it is important to note that the nature and severity of disease-related sequelae vary significantly across conditions. Stroke survivors, for instance, may face distinct challenges related to cognitive impairments and other sequelae,³⁹ while ACS, CCAD and HF patients may encounter barriers stemming from cardiac function and reduced exercise capacity.^{31,47} Although psychosocial and contextual factors are strong predictors of RTW regardless of diagnosis, these differences in residual impairments should not be overlooked when interpreting the findings. Including stroke within the broader spectrum of cardiovascular diseases is consistent with many epidemiological and policy definitions, but the unique challenges associated with stroke-related sequelae must be taken into account in clinical and occupational guidance.

These findings underscore the need for vocational rehabilitation (VR) strategies that integrate both common and disease-specific predictors to address the diverse needs of CVD patients effectively. In this respect, Slebus et al.²⁵ propose that universally accepted lists of items for consideration in work ability assessments can enhance communication between patients and stakeholders (e.g. general practitioners, cardiologists, occupational physicians, mental health professionals, employers, etc.) while aiding in the prevention of long-term work disability. Such lists, rooted in the WHO's ICF model,¹⁹ recognize that work ability is multi-causal and influenced by both disease-specific and non-disease-specific factors. Incorporating these comprehensive evaluations into clinical practice can provide a more nuanced understanding of an individual's capacity to RTW. Interestingly, many of the predictors identified in this review are non-modifiable. For example, several studies found that men were more likely to return to work

(RTW) after a cardiovascular disease (CVD), while being female was associated with decreased RTW rates.^{21–26,30,34} One review even identified gender as a common predictor of RTW across various injury and illness contexts.²⁸ Possible explanations for the lower RTW rates among women include social norms and expectations, gender-pay inequalities, differences in how work is valued, and sex-based disparities in treatment and access to rehabilitation.^{21,32,34} However, a notable limitation across the included reviews was the consistent underrepresentation of women in primary studies, which may contribute to an overestimation of gender effects. Interestingly, primary studies based on population-level data with a more balanced gender distribution found no significant RTW differences between men and women after adjusting for confounding variables.²⁶ Other non-modifiable predictors such as age, SES, type of cardiovascular event, or surgical intervention further emphasize the importance of early identification of individuals at risk of delayed RTW.

Building on these findings, several hypotheses emerge to guide future research and intervention development. Early screening to identify at-risk individuals, combined with personalized interventions targeting modifiable barriers, such as workplace adaptations and psychological support, may accelerate RTW and reduce long-term disability. Vocational rehabilitation programmes that address both disease-specific challenges (e.g. post-stroke sequelae, reduced cardiac function in ACS) and common factors (functional capacity, (psycho)social support) are likely to be more effective than one-size-fits-all approaches. In this context, workplace accommodations and active employer involvement are hypothesized to increase both the likelihood and sustainability of RTW outcomes. Multidisciplinary coordination among the involved healthcare providers, occupational physicians, and employers will be essential to successfully implement these personalized strategies.

A consistent finding across included reviews is that better health-related quality of life (HRQoL) facilitates RTW and vice versa.⁴⁸ By targeting the identified facilitators and barriers to RTW, interventions can simultaneously improve functional and psychological outcomes, promoting better HRQoL for individuals with CVDs. Recent forecasts indicate that the burden of CVD will continue to rise over the coming decades, driven by population ageing and the growing prevalence of cardiometabolic risks.^{3,4} This highlights the need for effective RTW interventions, not only to support individual recovery, but also to reduce the anticipated strain on healthcare systems and economic loss linked to prolonged work disability. As such, designing interventions that effectively target both common and disease-specific factors can help reduce long-term disability, improve work participation, and enhance overall societal and economic outcomes.

Limitations:

This review has several limitations that must be acknowledged. First, the heterogeneity of the included systematic reviews presents a significant challenge for this overview. Inconsistent definitions of RTW, variations in measurement approaches, differences in follow-up timeframes, and heterogeneity in study design (both quantitative and qualitative approaches), hindered the comparability of findings across studies. Additionally, cross-country differences in sickness, disability, and retirement benefits likely influenced RTW outcomes, further complicating the synthesis of results. However, findings by Kai et al. (2022) suggest that neither the method used to determine the coronary event (e.g. ICD codes, clinician expertise, or self-report) nor the approach to assessing RTW (e.g. self-reported or objective measures) influenced pooled prevalence estimates of RTW.³² This insight indicates that

methodological variations in these aspects may have a limited impact on the overall patterns observed, but further research is needed to confirm this across a broader context.

The methodological quality of the included reviews was assessed using the AMSTAR-2 tool,¹⁷ which, despite its adaptability, has limitations. The tool's ratings are heavily dependent on the selection of critical items, and by modifying these items, higher scores were achieved compared to the standard seven-item assessment. This highlights the subjectivity of AMSTAR-2 scoring, as some researchers argue that it lacks discriminant capacity due to a 'floor effect,' where most reviews are rated 'critically low.'⁵⁰ Leclercq et al.⁵¹ suggest adjustments, such as treating the exclusion of individual studies as a non-critical domain, to mitigate this issue and emphasize the importance of comprehensive literature searches and appropriate statistical analysis. Despite these challenges, AMSTAR-2 was chosen for its versatility in evaluating systematic reviews with mixed designs, ensuring a consistent quality assessment across diverse reviews.

Finally, conducting a 'review of reviews' introduces inherent challenges, including limitations in quantifying the strength of evidence for specific predictors. By synthesizing interpretations from reviews rather than analysing the primary studies, this approach risks distancing the analysis from original findings and complicates the assessment of the relative importance of predictors for RTW. The overlap among included reviews further hinders precise determination of which predictors exert the greatest influence, making it impossible to assign definitive weight or classify evidence as 'strong.' This limitation highlights the importance of cautious interpretation and the need for future research to validate these findings through primary data analyses that allow for robust quantification of predictors' effects.

Despite these limitations, this review is the first to provide a comprehensive overview of the literature on common and disease-specific RTW predictors after CVDs. It marks an important initial step towards a cross-disease approach to vocational reintegration and offers a foundation for improving RTW interventions and rehabilitation strategies.

Conclusion & implications for future research

This review identified both disease-specific factors (e.g. disease severity, characteristics, and treatments) and common predictors (e.g. functional capacity, psychological well-being, workplace characteristics, and social support) influencing RTW after CVDs. Addressing common predictors while implementing targeted and tailored interventions for disease-specific challenges, such as cognitive impairments or reduced cardiac function, can enhance vocational outcomes. In line with the ICF framework, these findings highlight the importance of assessing individual functioning across medical and contextual domains, beyond diagnosis alone. Rather than generic strategies, tailored vocational interventions should be informed by both shared and condition-specific predictors to improve RTW outcomes and health-related quality of life. Future research should explore the application of these findings in clinical practice and investigate their generalizability to other chronic conditions, further advancing the field of RTW rehabilitation and support.

Supplementary material

Supplementary material is available at *European Journal of Preventive Cardiology*.

Acknowledgements

We would like to thank Katrien Alewaeters, head of the medical library at Vrije Universiteit Brussel, specialized in systematic review search strategies, for reviewing and optimizing our search string. ChatGPT-4o was employed for language and grammar checks within the article. The authors carefully reviewed, edited, and revised the Chat-GPT-generated texts to their own preferences, assuming ultimate responsibility for the content of the publication.

Author Contribution

E.T., H.V.D., J.D.S., K.B., K.P., L.G., and P.C. contributed to the conception and design of this review of reviews on predictors of RTW following various CVDs. E.L., E.T., Z.V., and K.P. were responsible for data acquisition and analysis. Interpretation of findings was supported by the disciplinary expertise of J.D.S. (cardiology), K.B. (statistics), K.P. (health economics), L.G. (vocational rehabilitation), and P.C. (epidemiology). E.T. drafted the manuscript. E.L., H.V.D., J.D.S., K.B., K.P., L.G., P.C., and Z.V. critically revised the work. All authors approved the final manuscript and agree to be accountable for all aspects of the work, ensuring its accuracy and integrity.

Funding

This research was funded by the Marie-Louise Lottin bequest for scientific research on heart disease (VOPPU92 GEWEAAP1).

Conflict of interest: none declared.

References

- World Health Organisation (WHO). *Cardiovascular diseases (CVDs)*. <https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-cvds> (27 October 2023).
- Institute for Health Metrics and Evaluation (IHME). *GBD Results Tool*. <https://vizhub.healthdata.org/gbd-results/> (27 October 2023).
- Vollset SE, Ababneh HS, Abate YH, Abbafati C, Abbasgholizadeh R, Abbasian M, et al. Burden of disease scenarios for 204 countries and territories, 2022–2050: a forecasting analysis for the Global Burden of Disease Study 2021. *The Lancet* 2024;**403**:2204–2256.
- Chong B, Jayabaskaran J, Jauhari SM, Chan SP, Goh R, Kueh MTW, et al. Global burden of cardiovascular diseases: projections from 2025 to 2050. *Eur J Prev Cardiol* 2024; **zwae281**. Epub ahead of print.
- Luengo-Fernandez R, Walli-Attaei M, Gray A, Torbica A, Maggioni AP, Huculeci R, et al. Economic burden of cardiovascular diseases in the European Union: a population-based cost study. *Eur Heart J* 2023;**44**:4752–4767.
- Van Nieuwkerk AC, Delewi R, Wolters FJ, Muller M, Daemen M, Biessels GJ. Cognitive impairment in patients with cardiac disease: implications for clinical practice. *Stroke* 2023;**54**:2181–2191.
- Ashley KD, Lee LT, Heaton K. Return to work among stroke survivors. *Workplace Health Saf* 2019;**67**:87–94.
- Gragnano A, Negrini A, Miglioretti M, Corbière M. Common psychosocial factors predicting return to work after common mental disorders, cardiovascular diseases, and cancers: a review of reviews supporting a cross-disease approach. *J Occup Rehabil* 2018;**28**:215–231.
- Van De Cauter J, Bacquer DD, Clays E, Smedt DD, Kotseva K, Braeckman L. Return to work and associations with psychosocial well-being and health-related quality of life in coronary heart disease patients: results from EUROASPIRE IV. *Eur J Prev Cardiol* 2019; **26**:1386–1395.
- Bresseleers J, De Sutter J. Return to work after acute coronary syndrome: time for action. *Eur J Prev Cardiol* 2019;**26**:1355–1357.
- De Sutter J, Kacenelembogen R, Pardaens S, Cuyppers S, Dendale P, Elegeert I, et al. The role of cardiac rehabilitation in vocational reintegration Belgian working group of cardiovascular prevention and rehabilitation position paper. *Acta Cardiol* 2020;**75**:388–397.
- Schwarz B, Claros-Salinas D, Streibelt M. Meta-synthesis of qualitative research on facilitators and barriers of return to work after stroke. *J Occup Rehabil* 2018;**28**:28–44.
- Goorts K, Boets I, Decuman S, Du Bois M, Rusu D, Godderis L. Psychosocial determinants predicting long-term sickness absence: a register-based cohort study. *J Epidemiol Community Health* 2020;**74**:913–918.
- Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;**372**:n71.
- The EndNote Team. Endnote, eds. EndNote. 20 ed. Philadelphia, PA: Clarivate; 2013.
- Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. *Syst Rev* 2016;**5**:210.
- Shea BJ, Reeves BC, Wells G, Thuku M, Hamel C, Moran J, et al. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. *BMJ* 2017;**358**:j4008.
- Microsoft Corporation. *Microsoft Excel*. <https://office.microsoft.com/excel> (20 April 2024).
- WHO. *International Classification of Functioning, Disability and Health: ICF*. Geneva: World Health Organization; 2001.
- Heerkens YF, De Brouwer CPM, Engels JA, Van Der Gulden JWJ, Kant I. Elaboration of the contextual factors of the ICF for occupational health care. *Work* 2017;**57**:187–204.
- Coutts E, Cooper K. Return to work for adults following stroke: a scoping review of interventions, factors, barriers, and facilitators. *JBI Evid Synth* 2023;**21**:1794–1837.
- Green TL, McGovern H, Hinkle JL. Understanding return to work after stroke internationally: a scoping review. *Journal of Neuroscience Nursing* 2021;**53**:194–200.
- Karcz A, Trezzini B, Escorpizo R, Schwegler U, Finger M. Factors associated with sustaining work after an acquired brain injury: a scoping review. *Disabil Rehabil* 2022;**44**:6510–6530.
- Mortensen M, Sandvik R, Svendsen ØS, Haaverstad R, Moi AL. Return to work after coronary artery bypass grafting and aortic valve replacement surgery: a scoping review. *Scand J Caring Sci* 2022;**36**:893–909.
- Slebus FG, Kuijjer PP, Willems JH, Sluiter JK, Frings-Dresen MH. Prognostic factors for work ability in sicklisted employees with chronic diseases. *Occup Environ Med* 2007;**64**:814–819.
- Sun W, Gholizadeh L, Perry L, Kang K, Heydari M. Factors associated with return to work following myocardial infarction: a systematic review of observational studies. *J Clin Nurs* 2021;**30**:323–340.
- O’Neil A, Sanderson K, Oldenburg B. Depression as a predictor of work resumption following myocardial infarction (MI): a review of recent research evidence. *Health Qual Life Outcomes* 2010;**8**:95.
- Cancelliere C, Donovan J, Stockkendahl MJ, Biscardi M, Ammendolia C, Myburgh C, et al. Factors affecting return to work after injury or illness: best evidence synthesis of systematic reviews. *Chiropr Man Therap* 2016;**24**:32.
- Chen NYC, Dong Y, Kua ZZJ. Addressing mood and fatigue in return-to-work programmes after stroke: a systematic review. *Front Neurol* 2023;**14**:1145705.
- Guzik A, Kwolek A, Druzbicki M, Przysada G. Return to work after stroke and related factors in Poland and abroad: a literature review. *Work* 2020;**65**:447–462.
- Rivera EL, Aponte J, Montes MC, Adams CD, Gómez-Mesa JE. Factors associated with return to work after heart transplantation: a systematic review of the literature. *Am J Med Sci* 2021;**362**:586–591.
- Kai SHY, Ferrières J, Rossignol M, Bouisset F, Herry J, Esquirol Y. Prevalence and determinants of return to work after various coronary events: meta-analysis of prospective studies. *Sci Rep* 2022;**12**:15348.
- van Velzen JM, van Bennekom CAM, Edelaar MJA, Sluiter JK, Frings-Dresen MHW. Prognostic factors of return to work after acquired brain injury: a systematic review. *Brain Inj* 2009;**23**:385–395.
- Orange C, Lanhers C, Coll G, Coste N, Duthel F, Hauret I, et al. Determinants of return to work after a stroke: a systematic review and meta-analysis. *Arch Phys Med Rehabil* 2023;**105**:359–368.
- Sadeghi M, Rahiminam H, Amerizadeh A, Masoumi G, Heidari R, Shahabi J, et al. Prevalence of return to work in cardiovascular patients after cardiac rehabilitation: a systematic review and meta-analysis. *Curr Probl Cardiol* 2022;**47**:100876.
- Andersen EB, Kristiansen M, Bernt Jørgensen SM. Barriers and facilitators to return to work following cardiovascular disease: a systematic review and meta-synthesis of qualitative research. *BMJ Open* 2023;**13**:e069091.
- Brannigan C, Galvin R, Walsh ME, Loughnane C, Morrissey E-J, Macey C, et al. Barriers and facilitators associated with return to work after stroke: a qualitative meta-synthesis. *Disabil Rehabil* 2017;**39**:211–222.
- Jellema S, van der Sande R, van Hees S, Zajec J, Steultjens EM, Nijhuis-van der Sanden MW. Role of environmental factors on resuming valued activities poststroke: a systematic review of qualitative and quantitative findings. *Arch Phys Med Rehabil* 2016; **97**:991–1002.e1.
- La Torre G, Lia L, Francavilla F, Chiappetta M, De Sio S. Factors that facilitate and hinder the return to work after stroke: an overview of systematic reviews. *Med Lav* 2022;**113**:e202029.
- Haschke A, Hutter N, Baumeister H. Indirect costs in patients with coronary artery disease and mental disorders: a systematic review and meta-analysis. *Int J Occup Med Environ Health* 2012;**25**:319–329.
- Alves DE, Nilsen W, Fure SCR, Enehaug H, Howe EI, Løvstad M, et al. What characterises work and workplaces that retain their employees following acquired brain injury? Systematic review. *Occup Environ Med* 2020;**77**:122–130.

42. Donker-Cools BH, Daams JG, Wind H, Frings-Dresen MH. Effective return-to-work interventions after acquired brain injury: a systematic review. *Brain Inj* 2016;**30**: 113–131.
43. Hegewald J, Ewegewitz U, Euler U, Van Dijk JL, Adams J, Fishta A, et al. Interventions to support return to work for people with coronary heart disease. *Cochrane Database Syst Rev* 2019;**3**:CD010748.
44. Brouns R, Espinoza AV, Goudman L, Moens M, Verlooy J. Interventions to promote work participation after ischaemic stroke: a systematic review. *Clin Neurol Neurosurg* 2019;**185**:105458.
45. O'Brien L, Wallace S, Romero L. Effect of psychosocial and vocational interventions on return-to-work rates post-acute myocardial infarction: a SYSTEMATIC REVIEW. *J Cardiopulm Rehabil Prev* 2018;**38**:215–223.
46. Harskamp RE, Bagai A, Halkos ME, Rao SV, Bachinsky WB, Patel MR, et al. Clinical outcomes after hybrid coronary revascularization versus coronary artery bypass surgery: a meta-analysis of 1,190 patients. *Am Heart J* 2014;**167**:585–592.
47. Blokzijl F, Dieperink W, Keus F, Reneman MF, Mariani MA, van der Horst IC. Cardiac rehabilitation for patients having cardiac surgery: a systematic review. *J Cardiovasc Surg (Torino)* 2018;**59**:817–829.
48. Figueredo J-M, García-Ael C, Gragnano A, Topa G. Well-being at work after return to work (RTW): a systematic review. *Int J Environ Res Public Health* 2020;**17**:7490.
49. Standal MI, Aasdahl L, Jensen C, Foldal VS, Hagen R, Fors EA, et al. Subgroups of long-term sick-listed based on prognostic return to work factors across diagnoses: a cross-sectional latent class analysis. *J Occup Rehabil* 2021;**31**:383–392.
50. Karakasis P, Bougioukas KI, Pamporis K, Fragakis N, Haidich AB. Appraisal methods and outcomes of AMSTAR-2 assessments in overviews of systematic reviews of interventions in the cardiovascular field: a methodological study. *Res Synth Methods* 2024;**15**:213–226.
51. Leclercq V, Hilgsmann M, Parisi G, Beaudart C, Tirelli E, Bruyère O. Best-worst scaling identified adequate statistical methods and literature search as the most important items of AMSTAR2 (A measurement tool to assess systematic reviews). *J Clin Epidemiol* 2020;**128**:74–82.