

BMJ Open Mapping the evidence on the assessment of fitness to work at heights: a scoping review

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ABSTRACT

Objectives Falls from heights are a leading cause of workplace injuries and fatalities. Ensuring worker fitness is crucial, yet many countries lack formal guidelines for fitness for work (FFW) assessments, posing safety and legal risks. This scoping review sought to identify and map the existing evidence on the assessment of fitness to work at heights.

Design Scoping review following the Joanna Briggs Institute Scoping Review Methodology and Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews guidelines.

Data sources Searches were conducted in March 2024 across ProQuest Central, Google Scholar, PubMed, Scopus, ScienceDirect, Web of Science and PsycINFO. Grey literature was sourced from the websites of organisations including the International Labour Organisation, Safe Work Australia, Canadian Centre for Occupational Health and Safety, Health and Safety Executive (UK), Occupational Safety and Health Administration (USA), WHO, Centre for Construction Research and Training (USA), Institution of Occupational Safety and Health (UK), South African Society of Occupational Medicine, South African Society of Occupational Health Nursing and Institute for Work at Height (South Africa), in addition to general Google searches.

Eligibility criteria for selecting studies Our inclusion criteria encompassed both peer-reviewed and grey literature that addressed either ‘fitness for work at heights’, ‘fitness for work in high-risk settings requiring work at heights’ or human risk factors associated with working at heights.

Data extraction and synthesis A data extraction framework and guidance sheet were developed, piloted and refined through team discussions. An iterative review process was followed, with one author extracting and coding data while two authors conducted quality checks. Deductive qualitative content analysis was applied to the extracted data.

Results 68 articles met the inclusion criteria, but only 7 directly addressed fitness to work at heights, with the rest focusing on fitness to work in high-risk settings requiring work at heights or human risk factors associated with work at heights. This highlights a lack of peer-reviewed research specific to the topic. Key challenges included FFW assessments failing to reflect job demands, inconsistent application of FFW evaluations, lack of standardisation and inadequate stakeholder collaboration. Legal tensions between employer safety obligations

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This scoping review conducted a comprehensive search across multiple databases and grey literature, systematically mapping key characteristics of fitness for work (FFW) at heights.
- ⇒ The methodology followed a published protocol, using Joanna Briggs Institute scoping review methods and Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews guidelines to ensure rigour and transparency.
- ⇒ A multidisciplinary team of reviewers contributed to the study, enhancing its reliability and reducing the risk of bias.
- ⇒ Owing to the paucity of peer-reviewed literature on FFW at heights specifically, this study incorporates evidence from high-risk work settings that require work at height, which may restrict the specificity of some findings.
- ⇒ The review was restricted to English-language publications, potentially excluding relevant research published in other languages.

and worker rights were also noted. Critical human risk factors—such as physical and mental limitations, adverse states, human error and rule violations—significantly affected worker safety, though evidence of their specific impact in this context remained limited. Findings on the economic implications of FFW assessments were also inconclusive.

Conclusion Assessing FFW at heights is vital for worker safety, yet key challenges persist. This review highlights gaps in evidence on human risk factors and assessment methods. Findings emphasise the need for practice-based research, standardised fitness criteria and interdisciplinary protocols for preplacement assessment and ongoing monitoring.

INTRODUCTION

Working at heights is a common yet hazardous aspect of many industries, including construction, telecommunications, power utilities, and building maintenance and cleaning. Broadly defined, working at heights refers to any job with a risk of falling that could result in personal injury.¹ This includes tasks



performed above or below ground level where an individual could fall from an edge, through an opening or fragile surface, or from ground level into an opening in a floor or a hole in the ground.² Despite the routine nature of many tasks performed at heights, the risk of falls is significant and represents a major challenge to occupational safety. Falls from heights, also known as falls to lower levels, are a major cause of serious injuries and fatalities in workplaces worldwide.^{3–7} According to the US Bureau of Labor Statistics,⁸ there were 700 fatalities due to falls to lower levels in 2022, which was a 2.9% increase from 2021. In Great Britain, occupational falls from height were the leading cause of worker fatalities in 2022/2023.⁹ Addressing this risk not only aligns with the United Nations' Sustainable Development Goal 3 (SDG-3),¹⁰ which aims to ensure healthy lives and promote well-being at all ages, but also emphasises the prevention of workplace accidents and the protection of worker health in high-risk settings.

The risk factors for falls from height can be categorised as technical, organisational and human.¹¹ Human risk factors refer to individual characteristics, behaviours or conditions that increase the likelihood of accidents or injuries and include elements such as safety attitude,^{6 11–16} psychological well-being,^{15 17–23} physical and mental capacities,^{3 24 25} and substance use.^{14 26} Human risk factors significantly contribute to falls from height in the workplace.^{7 27–30}

Human risk factors and worker fitness are closely related in the context of occupational health and safety. Worker fitness refers to an individual's ability to work without endangering their own or others' health and safety.^{31 32} Serra *et al*³² described worker fitness as a multi-dimensional^{32–35} and dynamic concept, encompassing the worker's physical and mental capacity, the worker's risk in relation to their job demands and the work environment, and ethical, economic and legal considerations. Ensuring worker fitness is crucial for preventing workplace accidents in high-risk occupations,^{35–39} as emphasised by the International Labour Organisation Convention No. 161 (1985)⁴⁰ and government regulations in many countries.^{41–51} These regulations mandate fitness for work (FFW) assessments to ensure that workers can safely perform their duties without endangering themselves or others.^{50 52–57}

Despite the central role of FFW assessments in occupational health services and the evidence supporting worker fitness as a preventive measure for accidents in high-risk work settings, there remains a significant gap in the evidence regarding how FFW, and specifically FFW at heights, should be assessed. A 2007 systematic review by Serra *et al*³² highlighted the absence of scientific evidence concerning the criteria and methods used to assess FFW and called for further research in this domain. Similarly, a 2016 Cochrane review by Schaafsma *et al*³⁴ concluded that job-specific pre-employment examinations might help reduce occupational injury risks but also emphasised the need for higher-quality studies. Despite these

recommendations, no guidelines or consensus documents for assessing FFW at heights have been established to date. Recent literature^{32–34} addresses ethical, economic and legal issues associated with FFW assessment in general and cautions against discriminating against or excluding individuals from work that they can perform safely and productively.

The absence of empirical evidence and formal policies for evaluating FFW at heights leaves employers and health professionals without the necessary tools to make informed decisions about worker fitness. This deficiency not only places workers at risk but also exposes employers and health professionals to legal and reputational risks in the event of severe injuries or fatalities due to falls from heights.

REVIEW OBJECTIVE

The objective of this scoping review was to address a knowledge gap by identifying and mapping key characteristics related to the assessment of FFW at heights. Specifically, this review aimed to answer the question: 'What evidence exists regarding the assessment of FFW at heights?' To our knowledge, this is the first comprehensive analysis of evidence regarding the assessment of FFW at heights. This scoping review marks the first phase of a PhD study that aims to develop an interdisciplinary consensus statement for assessing FFW at heights in the South African construction industry, thereby contributing to the global commitment to enhance health and safety in high-risk occupational settings.

METHODS

A scoping review methodology was chosen for this review because it is the most suitable approach for examining emerging evidence on a topic that has not been comprehensively reviewed before.⁵⁸ We followed the Joanna Briggs Institute (JBI) Scoping Review Methodology⁵⁹ and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR)⁶⁰ checklist (online supplemental file 1). We registered a scoping review protocol on the Open Science Framework at osf.io/ys5gw and developed and published a protocol⁶¹ to predefine the objectives, methods and reporting of the review. Deviations from the published protocol are highlighted and discussed in this article. Neither patients nor the public were involved in the design, conduct, reporting or dissemination plans of this research.

Inclusion criteria

The inclusion criteria were established using the PCC (population, concept, context) framework recommended by JBI.⁵⁹ Given the paucity of peer-reviewed literature specifically addressing FFW at heights, we included not only studies directly focused on FFW at heights but also

those conducted in high-risk occupational settings where work at heights is required.⁶²

Population

Workers who perform tasks at heights or in high-risk settings where work at heights is required. This included individuals of any legal working age, gender, medical status or occupational background.

Concept

The assessment of an individual worker's suitability to work at heights, considering physical and mental capacity, health and their potential impact on performance and behaviour at work.³² Additionally, human risk factors specific to working at heights were included. Technical and organisational risk factors not inherent to the worker, such as management failures, environmental hazards (eg, wind or lightning), inadequate personal protective equipment or insufficient worker training, were excluded.

Context

Since work at heights is performed in various occupational settings, we reviewed literature from all countries, industries, locations and occupations.

Types of evidence sources

Both peer-reviewed and grey literature published in English between January 1993 and March 2024 were considered. Given that this scoping review is part of a broader study that focuses on the South African Construction industry, the starting point of 1993 aligns with the enactment of postdemocracy workplace health and safety laws in South Africa, including the Occupational Health and Safety Act, 1993⁶³ and the Compensation for Occupational Injuries and Diseases Act, 1993.⁶⁴

Search strategy

We started by conducting a preliminary search in ProQuest Central and Google Scholar databases to identify keywords in the titles and abstracts, as well as index terms that could serve as alternative search terms. A search string was then iteratively developed and refined to locate relevant literature. The search string was adjusted to match the syntax and search capabilities of selected scientific databases, including ProQuest Central, Google Scholar, PubMed, Scopus, ScienceDirect, Web of Science and PsycINFO. For the grey literature search, we compiled a list of keywords and key phrases for use on the following websites: International Labour Organisation; Safe Work Australia; Canadian Centre for Occupational Health and Safety; Health and Safety Executive, UK; Occupational Safety and Health Administration, USA; WHO, The Centre for Construction Research and Training, USA; Institution of Occupational Safety and Health, UK; South African Society of Occupational Medicine; South African Society of Occupational Health Nursing Practitioners; and the Institute for Work at Height, South Africa. Additionally, general searches were performed on Google. We limited the website searches to the first hundred results

by agreement. The detailed search strings and search terms, along with the results retrieved from each database or website, are provided in online supplemental file 2.

Following the search, all retrieved citations were imported into Rayyan systematic review software⁶⁵ and duplicate citations were removed. A checklist of inclusion criteria was then refined and compiled (online supplemental file 3).

Study selection

The first and third authors (LS and NC) independently carried out evidence screening and selection in two stages. First, they reviewed titles and abstracts using the inclusion criteria. Next, they obtained the full text of potentially relevant articles for further review against the inclusion criteria. Any disagreements were resolved through discussion and consensus. Where needed, the second author (TB) was consulted to facilitate agreement.

Data extraction

A framework for data extraction was developed by the first author (LS) using two theoretical models: the Human Factors Analysis and Classification System⁶⁶ (HFACS) and the concept of worker fitness proposed by Serra *et al.*³² The HFACS provides insights into the individual worker factors contributing to unsafe behaviours and accidents in the workplace. Levels 1 and 2 of the HFACS examine unsafe acts and preconditions for unsafe acts, particularly focusing on the condition of operators or workers. Serra *et al.*'s concept of worker fitness considers the worker's physical and mental capacity, the risks posed by job demands and the work environment, and the ethical, economic and legal considerations essential for ensuring safety. The data extraction framework included the following categories (figure 1): legal, regulatory and ethical compliance, economic issues, assessment process and methods, assessment process, and human risk factors intrinsic to the worker, which were further divided into physical limitations, mental limitations, adverse physiological states, adverse mental states, human error and human violation.

A draft data extraction table was created in Microsoft Excel with the identified categories captured in columns. A guidance sheet⁶⁷ defining each category for extraction was developed (online supplemental file 4). Both documents were piloted by all three authors on two peer-reviewed titles and two grey literature titles and finalised in a team discussion.

The data extraction was performed by the first author (LS), with a quality check conducted by the third author (NC) to ensure accuracy and completeness, as recommended by Pollock *et al.*⁶⁷ Regular team meetings were held throughout the data extraction process, during which questions or concerns were discussed and resolved by all three authors.

Data analysis

Delve software⁶⁸ was used to perform basic deductive qualitative content analysis on the collected data.

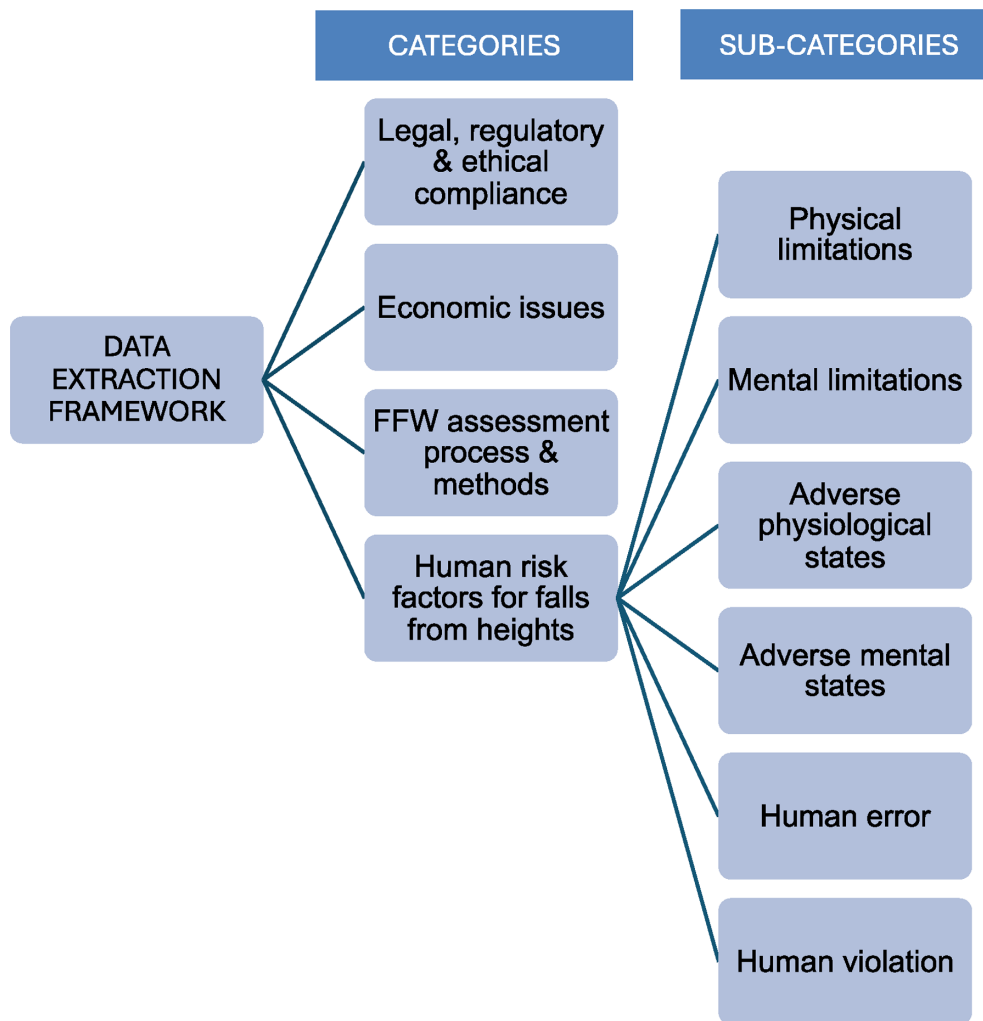


Figure 1 Data extraction framework categories and subcategories.

According to JBI recommendations,⁶⁷ basic qualitative content analysis is appropriate for scoping reviews that aim to identify key characteristics or factors associated with a concept.

The data were prepared for analysis in Delve using the following steps: first, the raw data from Excel were transferred to Google Sheets. Then, the data were organised, and category rows were combined for each article using concatenation formulas to merge the contents of corresponding cells into a single row. The merged results were pasted as values to maintain data integrity. This method preserved all information and optimised the dataset for analysis. After formatting, the Google Sheets were exported as CSV files and imported into Delve for qualitative analysis. This process included coding the data according to the various categories described in the data extraction guidance sheet. The data analysis was conducted by the first author (LS) and reviewed by the second and third authors (TB and NC). Any discrepancies were addressed and resolved through collaborative discussion.

RESULTS

Selection of studies

The search results are shown in the PRISMA⁶⁹ flowchart (figure 2). The initial search retrieved 573 articles. After removing 47 duplicates, 526 abstracts were screened by title and abstract. Subsequently, 212 articles were assessed in full text. Of these, 68 articles met the inclusion criteria.^{32–36 39 56 70–130} More information about the included articles can be found in online supplemental file 5.

Characteristics of included studies

The number of publications increased steadily from 1993 to 2024, with a slight decrease observed between 2010 and 2014 (figure 3a). Data collection locations were either international or unspecified for 27 articles. 15 articles originated from the USA,^{70 71 83 84 96 98 100 101 106 108 111 120 121 124 130} 10 from the UK,^{72 73 77 80 87 103 107 112 128 129} 4 each from South Africa^{76 81 113 127} and Australia^{78 82 119 123} and 2 each from Canada,^{85 93} India^{75 122} and the Netherlands.^{35 99} Malaysia³⁹ and the Philippines¹²⁵ each contributed one article (figure 3b). The presence of four South African articles^{76 81 113 127} is likely due to legal requirements in

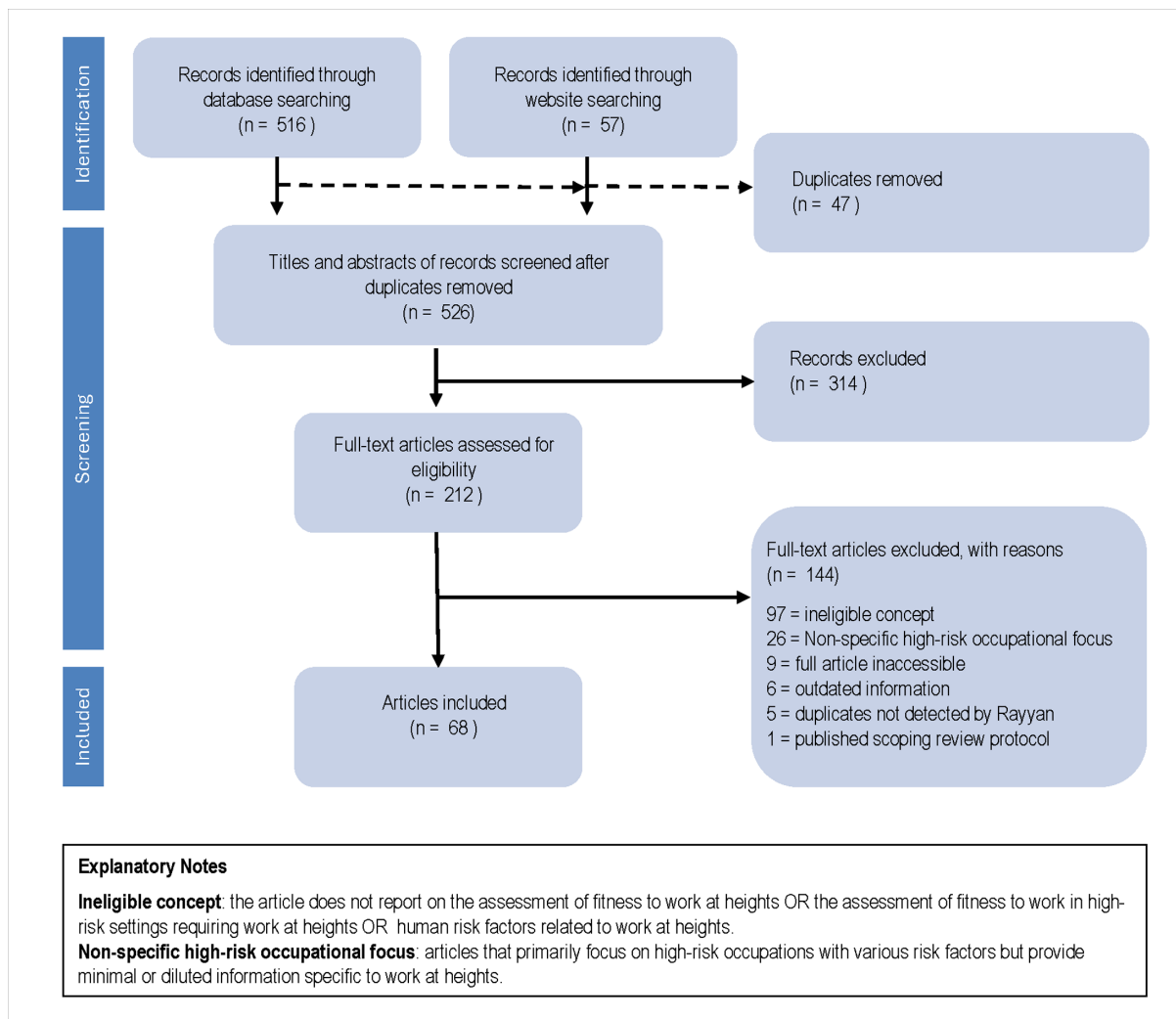


Figure 2 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram illustrating the article selection process.

South Africa mandating medical certificates of fitness in both the construction⁵⁰ and mining⁵² sectors, where work at heights is a key requirement.

Figure 3c illustrates the sources of evidence for the selected publications. Just over half (n=36) were sourced from peer-reviewed journals, including original research, reviews and theoretical articles. The remaining 32 articles originated from diverse sources of grey literature, including 10 informative articles^{70 71 81 96 98 101 107 109 120 130} comprising fact sheets, magazine articles and official websites of government or professional bodies. There were 10 professional reports or guidelines;^{75 80 82 83 117 122 124 126 127 129} 5 online marketing sources;^{72 73 77 78 105} 3 articles from online communities,^{76 84 85} including professional blogs, online advice forums and Q&A forums; 2 conference papers;^{56 79} 1 thesis¹¹³ and 1 press release.¹²³ Of the online marketing sources, four^{72 73 77 78} advertised medical assessments for working at heights in the UK,⁴¹ while one¹⁰⁵ promoted substance use testing in the USA.

The work settings of the selected articles are shown in figure 3d. Only seven articles^{72-74 77 81 122 126} specifically addressed work at heights. 34 articles did

not specify the industry or work activity. Of these, 20^{82-87 93 96 101 104-106 109-111 114-116 119 130} examined various human risk factors contributing to work-related accidents and injuries, including substance use, mental health, ageing and fatigue, while 14^{32 34 70 71 97 98 100 102 108 112 113 120 128} discussed various aspects of assessing fitness to work. The remaining 27 articles examined fitness to work in various high-risk occupations where heights may be required. These occupations included the transportation industry (n=10),^{78 88 92 94 99 117 118 124 125 129} the construction and maintenance industry (n=7),^{35 39 76 80 103 107 123} the energy and extractive industries (n=7)^{33 56 75 78 79 95 127} and the emergency/defence services sector (n=5).^{78 89-91 121}

Legal, regulatory and ethical compliance

58 articles (85.3%) addressed legal, regulatory and ethical compliance issues related to FFW. Within this category, five dominant characteristics emerged (figure 4): the employer's duty to protect workers' safety and health; worker privacy, confidentiality and non-discrimination; general ethical obligations such as beneficence, non-maleficence,

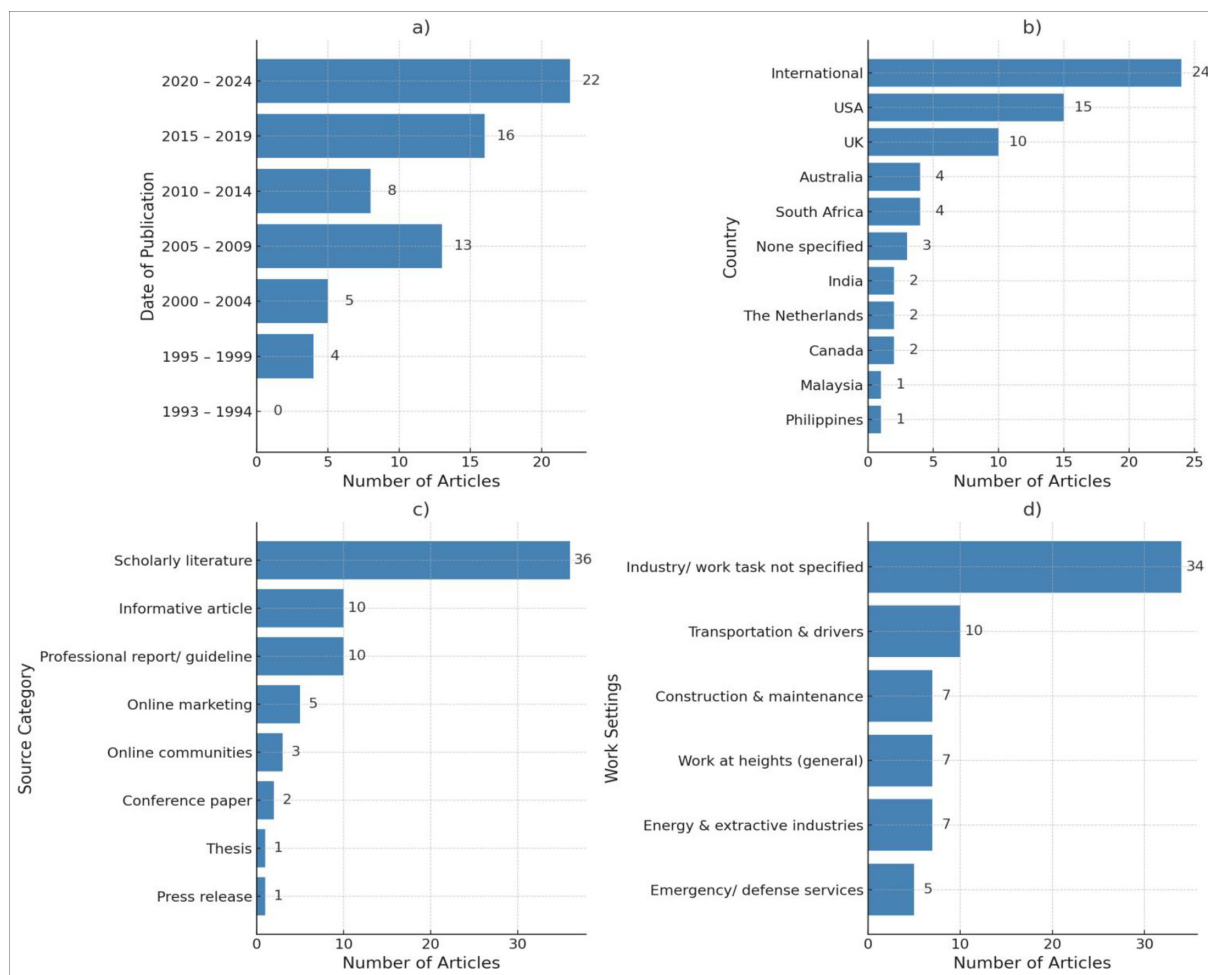


Figure 3 Characteristics of included studies. This figure presents the number of articles categorised by (a) year of publication, (b) country where evidence was gathered, (c) publication source and (d) work setting. One article⁶⁶ in category (d) specified three different work settings.

autonomy and justice; job-related testing and occupational fitness standards.

Employer's duty to protect the safety and well-being of their workers

28 articles highlighted national health and safety regulations requiring employers to maintain hazard-free workplaces and implement necessary safety measures to protect the health and safety of their workers.^{32 39 56 75 78 81 83 87 90 91 94-96 99 102-104 112 113 116-120 123 127 129 130}

The need for FFW testing in high-risk occupations^{95 99 120} and identifying and appropriately managing workers whose health conditions might compromise their ability to work safely and effectively^{90 91 102} was considered part of the employers' safety duty.

Worker privacy, confidentiality and non-discrimination

38 articles highlighted employers' legal obligations to prevent discrimination and safeguard the privacy and confidentiality of workers and job applicants.^{32-34 70-73 75 76 80 83-87 90 93 95-98 100-105 108-114 116 119 128 129} Rothstein *et al*¹⁰⁰ observed that FFW assessments are becoming more limited and focused in response to these legal and

ethical constraints. International differences regarding the legality of pre-employment FFW assessments were evident. Some countries have stringent regulations or outright prohibitions on FFW assessment prior to a job offer to protect worker privacy and prevent discrimination.^{32-34 111 113 128} Legal and ethical challenges with occupational medical examinations were also highlighted by several authors.^{32-34 100} These challenges stem from employers' obligation to ensure workplace safety while also respecting the rights of workers to employment, privacy and freedom from discrimination.^{103 111} Madan *et al*¹²⁸ suggested that fear of exclusion from employment might lead job applicants to conceal medical information during FFW assessments. Discrimination concerns specifically about age,^{90 102 116} mental health,^{109 111} disability¹¹¹ and gender¹¹⁰ were mentioned by various authors. The prudent handling of worker information gathered in FFW assessments was seen as crucial.¹¹⁹ Ultimately, the literature indicated the need for a careful balance between workplace safety and health, and protecting individuals from discrimination³²⁻³⁴ and individual privacy violations.^{80 85 93}

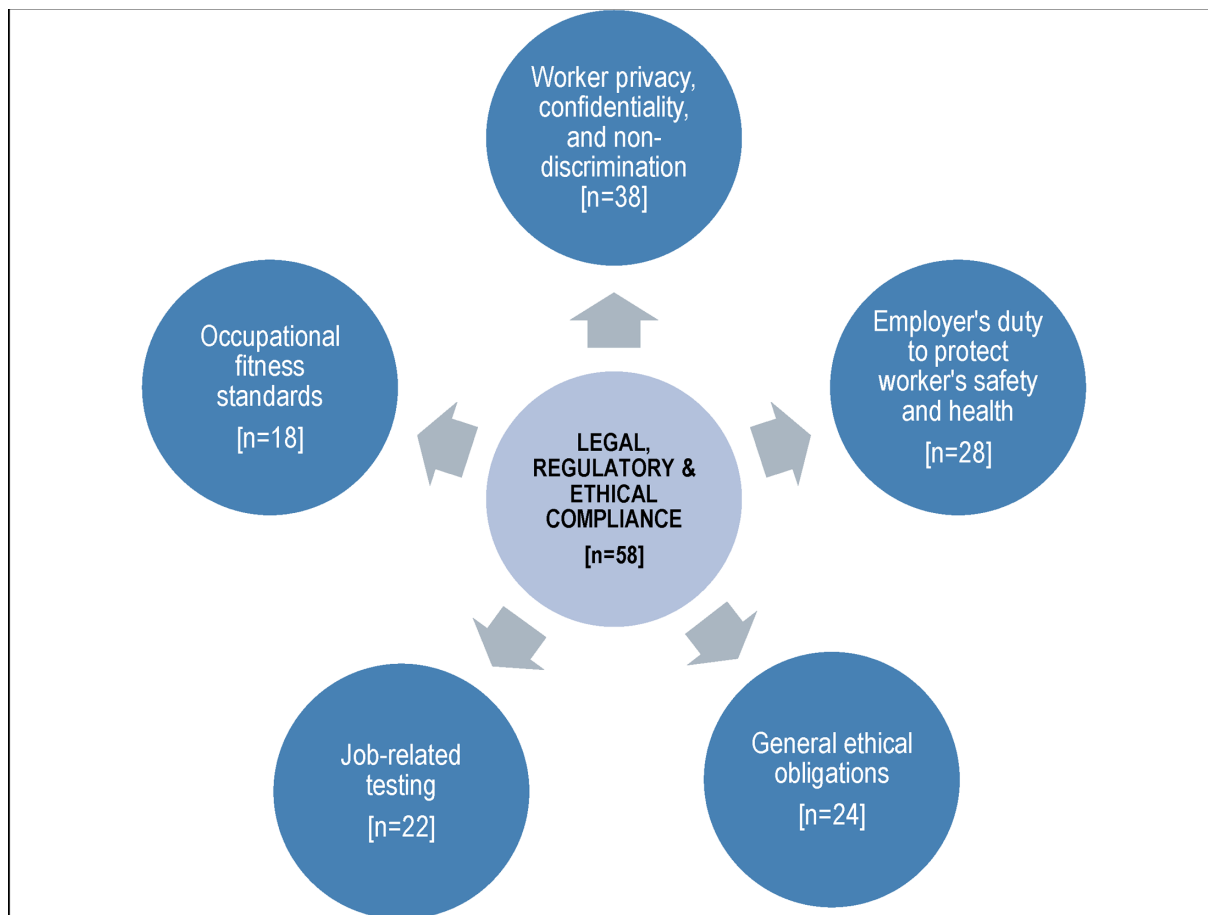


Figure 4 Dominant characteristics identified within the legal, regulatory and ethical compliance category.

General ethical obligations

The literature highlighted several ethical obligations of employers including not unfairly excluding workers from the workplace,^{71 95 100 118} recognising the value of employment for the individual,^{116 128} protecting workers against unnecessary testing^{32 110 113 119} and ensuring informed consent throughout the FFW assessment process.^{70 83 87 100 113 115 119} Various authors suggested that employers should assist workers whose health affects their ability to work safely and productively. This could include providing reasonable accommodations.^{32 34 87 90 107 112 116 117} Additionally, when a FFW assessment identifies health issues, appropriate interventions should be recommended.^{70 87 90 105 112 116 117 121 128} Some authors suggested that workers have an ethical responsibility to disclose any health conditions or medications that might impact their job performance and safety.^{94 129}

Job-related testing

There was a strong consensus that FFW testing conducted by the employer should be directly related to the physical and mental job demands.^{33–35 39 56 70 76 79 80 87 98 102 104 109 110 112–114 119 127} Job-related testing is legally required in several countries including Australia,¹¹⁹ the USA,⁹⁸ South Africa^{113 127} and The Netherlands. Some countries have legislation that prohibits employers from conducting pre-employment

medical examinations or making disability enquiries before a job offer is made, of which the Equality Act in the UK¹²⁸ and the Americans with Disabilities Act in the USA are examples.¹⁰⁹ One legal standard for job-related testing was found in the literature. The Meiorin Test^{102 110} is used in Canadian employment law to ensure that employment criteria set by employers genuinely reflect job requirements and are not unnecessarily discriminatory.

Occupational fitness standards

Several authors highlighted the absence of industry-specific occupational fitness standards as a major challenge.^{33 76 80 84 97 103 104 115 117 127} However, while such standards could guide and standardise FFW testing, they also face potential legal challenges, particularly concerning issues of unfair testing and discrimination.^{76 84 102} Despite these concerns, many authors felt that robust fitness standards are necessary, particularly in high-risk settings such as work at heights.^{33 35 80 97 102 103 115 117 127}

There was a significant increase in the number of articles addressing the assessment and management of substance impairment after 2015,^{83 84 86 93 103 105 106 123 124 129} following the legalisation of cannabis in some countries. Although most countries still have occupational safety laws prohibiting drug use and intoxication in the workplace, several authors noted that regulating substances, especially cannabis, has become challenging.^{83 84 103 105 106}



Wamuziri¹⁰³ pointed to a conflict between workplace laws, and specifically the delicate balance between a worker's right to privacy and an employer's duty to ensure the health and safety of everyone in the work environment.

Economic issues

38 articles^{32–36 39 56 70 71 73 75 77–80 83 86–88 90 92 95 97 98 102 104 106 108 118–120 123 124} commented on the economic implications of FFW assessment. They highlighted various economic advantages and disadvantages and some inconclusive effects.

16 articles reported positive economic benefits, with 75% (n=12) of these coming from grey literature sources, including informative articles,^{70 71 98 120} online marketing,^{73 77 78} professional reports,^{75 80 83} community posts⁸⁴ and conference papers.⁷⁹ Only four peer-reviewed articles,^{90 102 119} published between 2007 and 2013, reported positive economic benefits of FFW assessment. Positive economic benefits included preventing or reducing the risk of injury and associated costs,^{70 71 73 75 77–80 83 84 90 98 102 119} savings on insurance and long-term health costs,^{70 71 75 78 79 120} legal compliance,^{70 73 102} mitigating legal and financial risks following injury^{70 77 78 98 102} and improved worker productivity.^{71 78 83}

Conversely, eight articles, including seven peer-reviewed publications^{33 88 92 97 104 108} and one conference paper,⁵⁶ identified negative economic impacts of FFW assessment. The identified negative impacts included the high cost of implementing FFW assessments,^{33 56 88 97 104 108} an unproven cost-to-benefit ratio,¹⁰⁸ the expense of drug impairment testing^{88 92} and the impracticality and cost of preplacement assessment unless the injury risk is very high.¹⁰⁸ Additionally, evidence on the predictive value of FFW assessment for future worker health was found to be poor.^{32 108}

The findings from nine peer-reviewed articles,^{32 39 86 87 95 106 108 118} including four systematic reviews from 2006,³² 2016,³⁴ 2020⁸⁶ and 2024,³⁹ suggested that the economic value of FFW testing is inconclusive due to low quality or inconsistent evidence. Heng *et al*³⁹ specifically commented on on-site FFW evaluations, concluding that further research is needed to determine their practicality.

Assessment process and methods

Within this category, the assessment process is defined as the overall sequence of steps or activities followed to determine an individual's suitability for a particular job, while the assessment method is defined as the strategy, procedure and tools used to conduct the assessments, including the choice of tests or investigations.

Of the 68 articles, only 7^{39 74–76 80 122 130} specifically mentioned methods or tests for assessing fall risk in the workplace. These included obtaining a fall history from the worker,¹³⁰ and tests for balance,^{39 76 80 122} and acrophobia.^{74–76 122} However, 65 articles provided some discussion on processes or methods used in FFW testing in various high-risk occupations that could apply to work at height. Six dominant characteristics emerged from this

evidence, including reasons for FFW assessment; assessment process and types of tests; reliability and validity of testing; relevance to job demands; collaborative, multidisciplinary approach to FFW assessment; and recommendations for further research. These characteristics are illustrated in figure 5.

Reasons for FFW assessment

The review identified several key reasons for conducting FFW assessments. The most frequently mentioned reason was pre-employment assessments, which appeared in 22 articles.^{32–34 56 70–72 75–78 88 95 96 98 101 103 105 108 113 119 122} Other reasons included preplacement assessments (n=13),^{32 33 70 75–80 83 108 113 130} post-injury or illness assessments (n=10),^{32 33 70 72 96 101 103 105 108 113} annual or periodic medicals (n=9)^{56 70 78 80 88 101 103 113 130} and assessments when a worker's performance is thought to be compromised (n=7).^{70 72 83–85 96 101}

Relevance to job demands

The importance of ensuring that FFW assessments are tailored to the specific job requirements was widely acknowledged as a key legal concept.^{32–36 70 71 76 78 79 83 84 87 90 98 99 104 106 113–116 119 125}

However, there was little discussion on the methods for carrying out job-specific testing. Several authors suggested that conducting functional job analyses and/or risk assessments would help identify pertinent job-related information.^{32 33 36 71 87 98 102 108 119 120 122 127 128} Additionally, a few authors^{39 56 116 129} indicated that individuals conducting FFW assessments require a comprehensive understanding of the functional job demands. It was also noted that workers must clearly understand the work fitness standards and the reasons for their implementation.⁹⁰

Assessment process and tests used

31 articles indicated that FFW assessments typically include a general medical examination, often called a 'baseline medical'.^{33 35 56 70–73 75 77 78 80 81 83 88 98–100 104 107 108 112–114 116–118 120–122 127 130} The literature documented 26 individual tests or investigations that are used in FFW assessments where height work may be a risk. These are listed in table 1. Notably, the top 10 most frequently cited tests typically form part of a baseline medical examination, confirming the widespread use of baseline medicals in FFW assessments.

However, some authors raised concerns about relying solely on baseline medical evaluations to determine suitability for high-risk occupations such as work at heights. They argued that such evaluations often fail to adequately consider the unique demands of the job¹⁰⁸ and that relying exclusively on this type of testing offers limited value,¹⁰⁸ is insufficient^{87 98} and may even prove ineffective⁷¹ for assessing an individual's fitness for high-risk work.

Several authors suggested that functional capacity evaluation (FCE) is a reliable method for FFW testing.^{98 106 114 116 119 120 130} However, Pransky and Dempsey¹⁰⁸ raised legal, practical and scientific

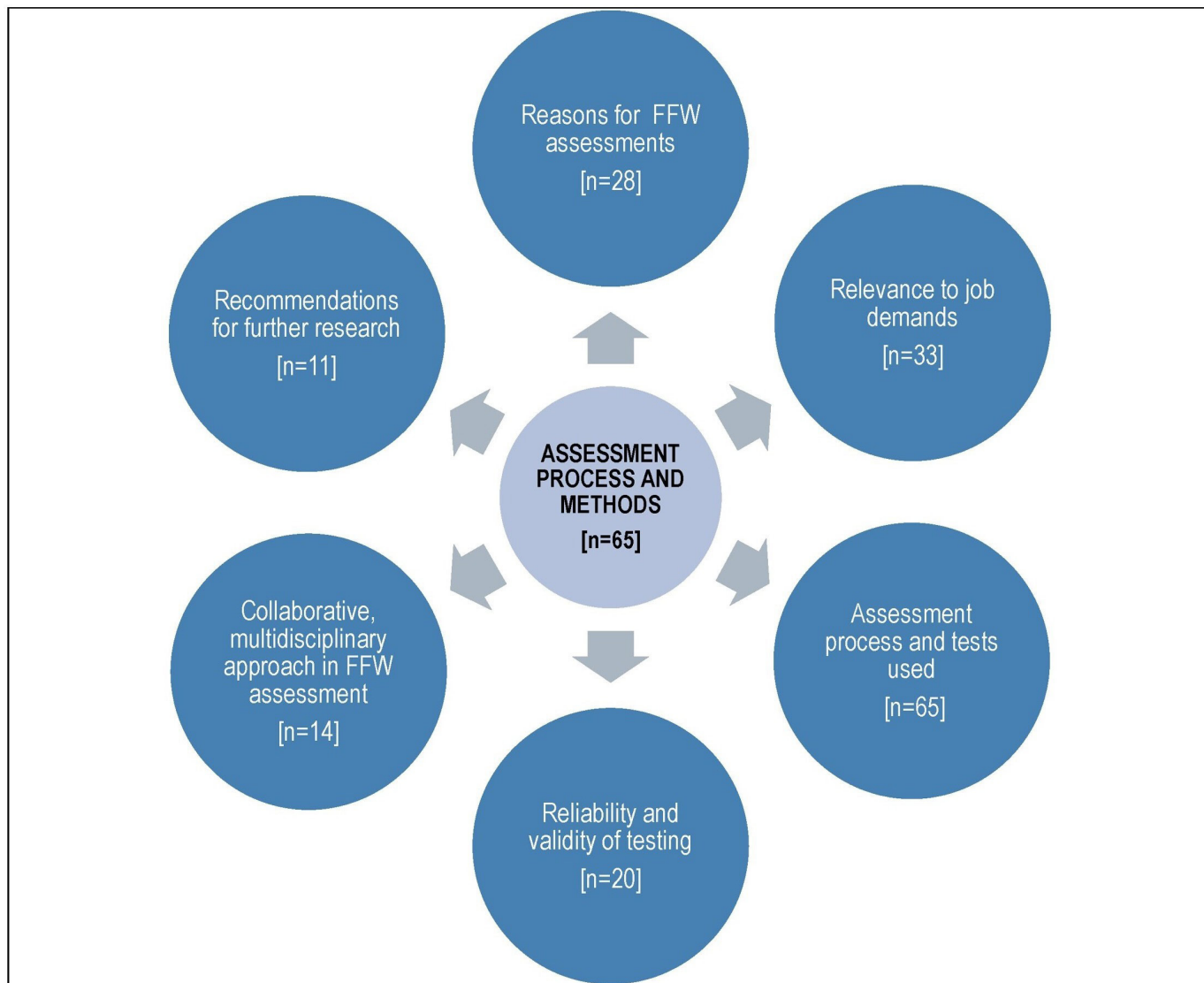


Figure 5 Dominant characteristics identified in the assessment process and methods category.

concerns about traditional FCEs. Specifically, they questioned the validity of FCE scores in predicting efficient and safe job performance. They did acknowledge that preplacement FCEs may help prevent injuries in physically demanding or high-risk jobs. They emphasised that optimising FCE validity involves accurately simulating job demands and conditions, ideally including environmental and psychological job demands, and not just physical job demands.

A number of articles referred to various functional or semifunctional tests, including cardiopulmonary exercise testing,^{33 56 72 77 90 120} assessment of fatigue and/or sleep function,^{39 82 89} and functionality-specific questionnaires.^{112 119} Several authors indicated the importance of obtaining a health history as a key component of the assessment.^{33 35 56 72 73 77 80 87 98 99 112} However, concerns were also raised about the effectiveness of relying solely on self-reported health complaints to detect work limitations.^{87 99} Furthermore, Madan *et al*¹²⁸ noted that relying solely on a

questionnaire for pre-employment health screening offers limited predictive value for identifying potential adverse health outcomes and injuries.

31 articles addressed psychological and cognitive factors in FFW assessment. Screening for problematic drug and alcohol use was the most frequently mentioned type of test. However, the evidence on the effectiveness of drug screening, particularly in pre-employment assessments, remains inconclusive.^{36 83 84 86 92 103 106} Other recommended psychological assessments included screenings for general mental health and depression,^{36 56 77 91 115 127} cognitive screenings for alertness, vigilance, clear judgement and communication skills;^{72 95 99 116} and psychological screening for fear of heights/acrophobia.⁷⁴ Pachman³⁶ cautioned against pre-employment screening for common mental health disorders, noting that mental health screening questionnaires and histories have not proven beneficial. Preisser *et al*⁹⁵ suggested that FFW assessments for high-risk

**Table 1** Types of medical and health-based tests in fitness for work (FFW) assessments and their citation frequency

Type of test	Frequency of citation (n)	Referenced article
1 Drug/substance use screening	17	35 56 77 78 80 83–85 92 105 107 112 120 121 123 124 129
2 Pulmonary function	13	33 39 56 72 73 75 77 78 107 112 120 122 130
3 Musculoskeletal/physical examination	13	33 72 73 77 78 80 98 99 107 112 119 120 130
4 Health history	11	33 35 56 72 73 77 80 98 99 119 130
5 Urine analysis	11	33 35 39 56 72 73 77 78 83 88 112
6 Hearing screening	11	33 56 72 73 77 78 104 107 112 114 116
7 Visual screening	11	33 56 72 73 77 78 99 107 112 116 130
8 Blood pressure, heart rate	10	33 39 56 72 73 75 78 88 107 122
9 Height, weight, body mass index (BMI)	9	33 39 56 72 73 77 78 88 121
10 Blood analysis	7	33 35 56 73 77 83 112
11 Cardiopulmonary exercise testing	7	33 56 72 77 90 112 120
12 Functional capacity evaluation	7	98 106 114 116 119 120 130
13 Cognitive/alertness screening	6	39 72 80 95 99 119
14 Balance screening	4	39 76 80 122
15 Functionality-specific questionnaires	4	108 111 112 119
16 Acrophobia/height simulation test	4	74–76 122
17 Mental health screening	3	56 77 115
18 Eye-hand coordination	3	76 80 106
19 Nystagmus	3	75 100 122
20 Neurological screening	3	78 80 122
21 Fatigue/sleep assessment	3	39 82 89
22 Handgrip strength	2	39 77
23 Depth perception	1	76
24 Falls history	1	130
25 Vibratory testing	1	130
26 Abdominal examination	1	78

This table presents the medical and health-based tests used in FFW assessments, as identified in the scoping review. It includes the number of articles citing each test, along with references to the relevant articles.

occupations should also evaluate the worker's ability to assess risk, communicate effectively, collaborate reliably with colleagues and manage unanticipated situations competently.

Reliability and validity of testing

Concerns were expressed regarding high subjectivity and low reliability of FFW testing among the healthcare practitioners conducting these assessments.⁹⁷ Some authors highlighted the lack of agreement on appropriate cut-off points for many of the tests being used,^{36 118} or on the acceptable level of risk allowed in FFW testing.¹¹⁸ Others pointed to the absence of empirical evidence regarding the effectiveness of pre-employment or preplacement assessments in preventing injuries and health risks in high-risk jobs.^{32 33 36 87 94 97 99} Several authors maintained that high-risk occupations require more stringent FFW testing standards than general occupations.^{33 36 80 83 90 95 98 105 107} The importance of developing specialised FFW testing policies and protocols for high-risk occupations was supported by

a number of authors.^{32 85 102 103 105 114 118} Pransky *et al*¹⁰⁸ asserted that FCE validity is optimal when paired with a detailed job analysis and accurate job simulation.

Collaborative, multidisciplinary approach in FFW assessment

It was commonly proposed that the evaluation of FFW for high-risk occupations should involve a collaborative, multidisciplinary approach. This approach should include the employer, occupational health professionals and the workers themselves.^{70 94 112} The responsibility for approving the FFW certificate was generally attributed to the occupational health physician.^{33 56 70 72 75 76 80 120 129} Other professionals involved in medical testing included occupational health nursing practitioners^{33 56 72 73 76 80 130} and occupational health technicians.^{73 80} Additionally, physiotherapists^{98 120} and occupational therapists⁹⁸ were recognised as appropriate professionals for conducting physical job-simulated testing. However, none of the articles specifically addressed which

professionals should be responsible for conducting mental or psychological screening.

Recommendations for further research identified in the reviewed literature

The literature review highlighted the need for further research related to FFW testing in the context of work at heights. Several authors pointed out a significant gap in scientific evidence, emphasising the critical need for more comprehensive research.^{32 33 36 87 99 108} They emphasised the need to develop measures that are valid, reliable and closely correlated with safe, effective and sustained work performance, tailored to meet specific job demands.^{34 90 94 108 125} Pachman³⁶ suggested creating consensus-based guidelines supported by validation trials, while Glozier¹⁰⁹ stressed the importance of conducting studies on the impact of mental illness on work performance. Sherry¹¹⁷ advocated for establishing medical standards for sleep disorders. Additionally, Biasutti *et al*⁸⁶ called for a clearer understanding of the relationship between cannabis use and occupational injuries, and Pransky *et al*¹⁰⁸ proposed research to link FCE results with occupational outcomes.

Human risk factors

42 articles discussed various conditions, characteristics or limitations that individual workers might bring to their work situation, potentially affecting their safety and performance, particularly in high-risk settings such as working at height.^{33 36 39 70 72 74 75 79 82–86 88–96 99 104–106 109–111 114 116 117 119 121–127 129 130} These human risk factors were subcategorised according to the data extraction framework into physical limitations (n=24), mental limitations (n=23), adverse physiological states (n=23), adverse mental states (n=21), human error (n=14) and human violations (n=7). Various human risks emerged for each subcategory. Table 2 details the risks identified within each of the six subcategories, along with their corresponding references.

The subcategories of physical and mental limitations included chronic or inherent impairments or disabilities with underlying medical pathology. Physical limitations frequently mentioned in the literature included cardiovascular and respiratory impairments, neurological and sensory impairments, musculoskeletal and mobility impairments, and metabolic syndrome, particularly obesity. Frequently mentioned mental limitations included anxiety and fear disorders, substance use disorders, sleep disorders, mood and emotional regulation disorders, cognitive and communication disorders, and age-related mental decline.

The subcategories of adverse physiological and mental states included temporary physical and mental conditions influenced by external factors, which have a negative impact on functional performance. Notable physiological states identified in the literature included the effects of substances/medications on physical function, physical fatigue, common medical illnesses, and environmental

and situational stressors. Notable mental states included cognitive dysfunction, stress and mental fatigue responses, behavioural responses, and emotional and psychological responses.

Human error was defined as actions or decisions that deviated from expected or required standards, increasing the risk of accidents. Identified risks included cognitive errors, fatigue, worker inexperience and impulsive behaviours. Human violation was defined as conscious deviations from procedures or rules, including failure to follow procedures, unsafe attitudes, working without authorisation and criminal behaviours.

Only eight studies specifically examined the incidence of workplace accidents and injuries in relation to human risk factors. The risk factors examined in these studies included ageing,^{90 114 116} acrophobia,⁷⁴ cannabis use,⁸⁶ obstructive sleep apnoea,⁸⁸ fatigue and sleep inertia,⁸⁹ and auditory fitness.¹⁰⁴

The research identified five human risk factors that span multiple subcategories, highlighting their complex and multicausal nature. These factors are (1) the impact of drugs, medications, and substances on performance; (2) cognitive dysfunction; (3) sleep problems and fatigue; (4) anxiety and emotional dysfunction; and (5) age-related decline. Table 3 details these human risk factors, the subcategories they encompass and their functional effects on work performance as documented in the literature.

DISCUSSION

This scoping review explored how FFW is assessed in the context of working at heights. Our analysis included 68 articles from both peer-reviewed and grey literature sources. We used a data extraction framework^{32 66} to categorise the data into four categories, namely, legal, regulatory and ethical compliance; economic issues; FFW assessment processes and methods; and human risk factors for falls from heights.

Significant gaps in the literature

The review found significant gaps and challenges within the existing literature. Despite the relevance of this topic across various high-risk occupations, only seven articles^{72–74 77 81 122 126} directly addressed fitness to work at heights, with just one⁷⁴ undergoing peer review. This gap underscores the need for more targeted research in this area, particularly in peer-reviewed contexts where rigorous methodologies can be applied and validated.

Characteristics of selected articles

The review identified a steady increase in publications related to this topic since 1994, with just over 55% of articles published in the last decade. This trend suggests a growing awareness of the importance of managing human risk factors in the workplace, particularly in high-risk occupations, and work at heights in particular. A global relevance of the findings is evident, given the diverse geographical origins of the studies. The inclusion of grey

Table 2 Subcategories of human risk factors contributing to falls from height identified in the literature with corresponding literature references

Subcategory	Subcategory definition	Identified risks (number of articles that mentioned each risk)	Article references
Physical limitations (n=24)	Includes chronic or inherent physical impairments or disabilities with underlying medical pathology that can restrict an individual's capacity to perform tasks as required.	Cardiovascular and respiratory impairments (n=15) Neurological and sensory impairments (n=10) Musculoskeletal and mobility impairments (n=10) Metabolic syndrome (n=9) Other physical and medical impairments (n=5)	33 70 72 79 82 88 90 91 95 114 116 117 119 127 130 33 75 77 91 104 116 122 127 129 130 33 70 85 91 110 116 119 127 129 130 33 70 72 79 88 91 119 127 130 39 72 91 94 127
	Includes chronic or inherent mental impairments or disabilities with underlying medical pathology that can restrict an individual's capacity to perform tasks as required.	Anxiety and fear disorders (n=7) Substance use disorders (n=7) Sleep disorders (n=7) Other mental health disorders (n=7)	33 70 74 75 91 119 122 33 70 91 105 121 127 130 33 70 82 88 91 117 121 33 70 72 85 91 111 127
		Mood and emotional regulation disorders (n=6) Cognitive and communication disorders (n=3) Age-related mental decline (n=4)	33 70 91 115 119 127 91 99 109 90 91 114 116
		Effects of substances/medications on physical function (n=15) Physical fatigue (n=12) Common medical illness (n=8) Environmental and situational stressors (n=5)	33 70 72 82-86 91-93 96 109 106 121 33 39 70 82 85 88 89 91 92 117 121 125 33 70 72 82 83 85 90 91 33 74 82 91 95
Adverse physiological states (n=23)	Physical limitations that are transient and may impact on a person's physical abilities and performance. These states are often influenced by external factors and can vary greatly depending on health status, environmental conditions, and personal behaviours.		
Adverse mental states (n=21)	Psychological or mental limitations that are transient and may impact an individual's mental capabilities and behaviours. These states are often influenced by external factors and can vary greatly depending on health status, environmental conditions and personal behaviours.	Cognitive dysfunction (n=13) Stress and mental fatigue responses (n=9) Behavioural responses (n=5) Emotional and psychological responses (n=4)	39 82-85 88 89 91 93 96 109 126 129 33 39 82 85 89 91 117 121 126 70 83 91 106 123 74 75 89 122
Human error (n=14)	Refers to actions or decisions made by individuals that deviate from what is intended, expected or required, leading to undesirable outcomes and increased accident risk.	Includes factors such as cognitive errors, fatigue, worker inexperience, and impulsive personalities that lead to increased accident risk	39 83-85 88-90 96 110 111 116 117 121 125

Continued

Table 2 Continued

Subcategory	Subcategory definition	Identified risks (number of articles that mentioned each risk)	Article references
Human violation (n=7)	Refers to conscious and/or deliberate deviations from established procedures, rules or regulations, significantly increasing safety risk	Includes factors such as failure to follow rules/procedures, unsafe attitudes, foolish behaviours, working without authorisation, and criminal/antisocial behaviours	36 39 70 83 85 124 126
Note: Numerous articles mentioned multiple subcategories and characteristics.			

literature alongside peer-reviewed articles provides a more comprehensive view of the current state of research and practice, combining theoretical research with practical insights.

Legal, regulatory and ethical compliance

This scoping review identifies significant legal, regulatory and ethical challenges associated with FFW assessments in high-risk occupations requiring work at heights. A central concern is the legal tension between an employer's duty to ensure workplace safety and the protection of workers' rights,^{103 111} including privacy and confidentiality,³²⁻³⁴ and the rights to employment and freedom from discrimination.^{34 95} This tension is further exacerbated by the absence of industry-specific occupational fitness standards^{33 35 97 102} for such roles. Without these standards, it is challenging to define the necessary physical and mental capabilities required for safe and effective performance in high-risk jobs. The lack of rigorous standards not only raises ethical concerns about employer responsibility and worker welfare but also poses legal risks. Employers may face non-compliance with workplace safety regulations, leading to liability and potential litigation if workers are injured due to inadequate fitness assessments.

The review also highlights a significant lack of empirical evidence supporting the effectiveness of pre-employment or preplacement assessments in preventing workplace injuries and health risks.^{32 33 36 87 94 97 99} This deficiency raises concerns about the validity of FFW assessments and their ability to genuinely ensure worker safety and suitability, potentially putting employer obligations and worker protections under the law at risk.

Given the complex interplay between legal obligations and ethical considerations surrounding FFW assessments, it is essential to develop clear legal frameworks and guidelines. These frameworks should aim to reconcile the conflicting interests of employers and workers, ensuring that FFW assessments are conducted fairly, transparently, and with due respect for the responsibilities and rights of both parties.^{32-34 80}

Assessment processes and methods

This scoping review highlights several critical challenges, gaps and opportunities in current FFW assessment practices for high-risk occupations involving work at heights.

Standardisation and variability issues

There is a notable lack of standardised assessment methods,^{35 102-104 115} coupled with significant variability in practices among health professionals.⁹⁷ This stems from the absence of industry-specific occupational fitness standards.^{33 35 97 102}

Over-reliance on baseline medical examinations

Baseline medical examinations focus on general health^{71 87 98 108} and overlook the specific physical, mental and behavioural capacities needed for safe job performance, compromising the effectiveness of the assessment.⁹⁷

**Table 3** Multicategory human risk factors affecting worker performance and safety

Human risk factor	Subcategory	Effect on function	No. of articles referencing (n)
Effects of drugs/medications/substances on worker performance/safety	Adverse physiological states	Effects on physical function while under the influence.	15
	Mental limitations	Substance use disorder	7
	Adverse mental states	Effects on cognitive function/behaviour while under the influence	4
	Human violation	Use of illegal drugs in the workplace Workers cheating on drug tests	1
Cognitive dysfunction	Adverse mental states leading to human error	Temporary cognitive impairment/cognitive failure	18
	Mental limitations	Cognitive/communication impairments	4
Sleep problems/fatigue	Adverse physiological states	Sleep deprivation leading to physical fatigue	8
	Mental limitations	Sleep disorder	7
	Adverse mental states	Sleep deprivation leading to mental fatigue, stress and cognitive problems	3
	Human error	Sleep deprivation leading to increased accident risk	3
Anxiety/emotional dysfunction	Mental limitations	Anxiety disorder	4
		Acrophobia	3
	Adverse mental states	Fear of height leads to divided attention	3
	Adverse physiological states	Fear of height may cause physiological effects – impairs motor skills	1
Age-related dysfunction/decline	Physical limitations	Reduced mobility, strength, coordination, balance	6
	Mental limitations	Reduced cognitive functions	3

Validity and reliability concerns

Common FFW assessment methods such as drug screenings,^{86 92 103} FCEs¹⁰⁸ and psychological assessments³⁶ have high levels of subjectivity³⁶ and an absence of uniform cut-off points.¹¹⁸ These factors compromise the assessments' validity and reliability.

Emerging health issues

Current FFW protocols often neglect emerging issues like cannabis use,⁸⁶ sleep disorders¹¹⁷ and mental health impacts,¹⁰⁹ which are increasingly relevant in modern workplaces.

Weak empirical support

There is insufficient empirical evidence to demonstrate that FFW assessments effectively prevent workplace injuries.^{32 33 36 87 94 97 99} This lack of evidence questions the utility of current tools in predicting a worker's suitability for high-risk tasks such as working at heights.

Mismatch with job requirements

Despite the legal emphasis on job-related testing, FFW assessments frequently fail to reflect true job requirements,^{36 39 95} potentially leading to mismatches between a worker's capabilities and job demands. A thorough assessment of functional job demands should inform the FFW assessment.^{32 33 39 128 129}

Need for a multidisciplinary approach

The literature advocates for a multidisciplinary approach to FFW assessments, involving collaboration among various health professionals.^{70 94 112} However, this approach may face challenges in role determination and coordination among stakeholders.

Overall, the literature highlights a critical need for improvement in FFW assessment practices, advocating for the development of consensus-based guidelines and rigorous validation studies to establish effective, reliable and job-relevant assessment methods. Moreover, it calls

for integrating new research findings into FFW protocols to address emerging health concerns effectively.

Economic impact

The literature presents a somewhat contradictory picture of the economic impact of FFW assessments. While many articles, primarily from grey literature sources, suggested that FFW programmes can lead to cost savings by preventing workplace injuries,^{73 75 77 78 84} ensuring regulatory compliance,^{73 77 78 98 102} promoting savings on insurance^{71 75 78 79 120} and improving employee productivity,^{71 78 83} these reports lacked rigorous peer review, raising concerns about their reliability and general applicability.

In contrast, peer-reviewed studies frequently highlighted the substantial costs involved in implementing and maintaining FFW assessments, including testing, administrative overheads and potential legal challenges.^{33 36 88 97} Some authors questioned the cost-effectiveness of FFW programmes, pointing out that the benefits are often unclear or unproven.^{36 108}

This discrepancy underscores the need for more comprehensive and rigorous economic evaluations of FFW assessments to determine their true cost-to-benefit ratio. There is a pressing need for evidence-based research to guide policy decisions in occupational health and safety, ensuring that FFW programmes are both effective and economically viable.

Human risk factors

The literature underscores the complex, multicausal nature of human risk factors that individual workers may introduce to high-risk environments, such as working at heights, affecting both safety and performance. While physical and mental limitations, as well as adverse physiological and mental states, were frequently highlighted as significant risk factors (figure 5), human error and violations received less attention. This discrepancy is possibly due to traditional FFW assessments focusing predominantly on physical and, to a lesser extent, mental health, leaving the more nuanced aspects of human behaviour linked to errors and violations underexplored. A critical challenge identified is differentiating between pathological conditions, which can be detected through medical assessments, and functional capacity—the worker's actual ability to perform tasks safely and effectively.^{32 33 36 87 99} Legal and ethical standards advocate for focusing on functional capacity rather than merely the presence of medical conditions.^{32–34 36 70 95 99} The variability of temporary conditions, the long-term effects of persistent issues and the influence of situational factors emphasise the need for ongoing, adaptable assessments that account for changes in a worker's health status and the dynamic nature of their job and work environment.

Study limitations

This scoping review had several limitations. Given the paucity of literature specifically addressing FFW at heights,

we included studies conducted in high-risk occupational settings where working at heights is typically required, alongside those directly focused on FFW at heights. While this approach provided valuable contextual insights and enabled a broader exploration of the topic, some findings may not be fully specific to work at heights.

The review was further limited to English-language articles, which may have excluded relevant studies published in other languages. Finally, data extraction was conducted by the first author, with quality checks and collaborative input provided by the second and third authors. While this approach aligns with JBI methodology,⁶⁷ it does not fully meet the ideal standard of involving two or more reviewers throughout the process to ensure greater rigour.

CONCLUSION

The findings of this scoping review highlight the critical importance of assessing FFW at heights, given the significant legal, ethical and practical considerations involved. However, current practices reveal substantial deficiencies in standardisation, reliability and relevance to the specific demands of working at heights. This review identifies notable gaps in the literature regarding both the human risk factors for falls and the methods used to evaluate workers' fitness, underscoring the need for more robust and validated assessment methods and tools.

While FFW assessments have the potential to deliver economic benefits through risk reduction and legal compliance, their overall impact remains uncertain. Contradictions between non-peer-reviewed sources, which emphasise positive economic outcomes, and peer-reviewed studies, which report high costs and ambiguous benefits, indicate a need for further research to address these disparities.

Assessing FFW at heights requires more than diagnosing medical conditions; it demands a comprehensive evaluation of how these conditions affect a worker's ability to safely meet job demands. Legal and ethical considerations further highlight the need for adaptive assessments that accommodate changes in both worker health and job requirements, ensuring a flexible, case-by-case approach rather than a one-size-fits-all model.

Moreover, FFW assessments should not only identify individuals who are unsuitable for specific roles but also serve as a preventive measure by proactively enabling workers to perform their jobs safely and effectively. This dual-purpose approach can be supported through workplace interventions such as tailored training programmes, ergonomic adjustments and proactive health management strategies, all of which can reduce the risk of injuries and promote long-term occupational health.

To address current gaps in FFW assessment practices, there is a need for collaborative, evidence-based research. Future studies should focus on defining the physical and mental demands of working at heights, establishing consensus-based fitness standards and developing interdisciplinary procedures for both preplacement and

periodical assessments. These efforts should also incorporate applied, practice-based research, such as field studies and the systematic collection of workplace experiences. By gathering real-world data from clinical and occupational settings, researchers can validate assessment methods, evaluate their effectiveness and identify areas for improvement.

Such initiatives are crucial not only for enhancing worker safety and well-being but also for ensuring legal and ethical compliance while supporting workers in performing their duties sustainably and without injury or disease.

Differences between protocol and review

- ▶ Given the paucity of literature on fitness to work at heights, the inclusion criteria were refined during the review selection phase to incorporate studies on fitness to work at heights or in high-risk occupational settings requiring work at heights.
- ▶ Due to time and resource constraints, one author performed the data extraction with a second author reviewing a portion of the extraction as described by Pollock *et al.*⁶⁷
- ▶ The use of Delve software to facilitate the basic deductive qualitative content analysis was not reported in the protocol.
- ▶ We did not use Cohen's kappa to determine inter-rater agreement at the full-text review stage. Instead, we opted for a qualitative consensus approach, which aligns more closely with JBI scoping review methodology^{58 59} and provided the flexibility needed to accommodate nuanced judgments required during full-text assessment.
- ▶ We did not allocate a level of evidence rating to each source, as this is not recommended in the JBI scoping review methodology.

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Contributors LS conceptualised the study and is the principal investigator. LS designed the study protocol and developed the search strategy with guidance and input from NC and TB. LS and NC performed the evidence screening, with TB contributing to consensus discussions. LS performed the data extraction, analysis and produced the initial draft of the manuscript. NC and TB provided significant guidance and input on finalising the manuscript. All authors read and approved the final manuscript. LS is the guarantor. Two AI tools were used for language editing: (1) Grammarly—improve my writing prompt; (2) ChatGPT—prompt: 'Edit for clarity and grammar'. ChatGPT was used to generate the bar graphs in Figure 3.

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