Mental Awareness, Respect and Safety in the mining industry – The Landmark Study: A review and synthesis of the literature

Report prepared for the Western Australian Government

October 2022

Preface

The Mental Awareness, Respect and Safety (MARS) Landmark Study is a four-year research and evaluation project led by ARC Laureate Fellow Professor Sharon Parker at the Centre for Transformative Work Design (CTWD).

The Landmark Study (LMS) was commissioned by the Western Australian Government to design and implement a research and evaluation project focused on the mining industry, regarding three focus areas: 1) creating mentally healthy workplaces – by managing psychosocial hazards and promoting positive practices at work that support mental health and wellbeing; 2) building a culture of safety and respect – with safe, gender-equitable, respectful and inclusive workplaces; and 3) preparing for workplace safety in the future mine – by addressing emerging risks and fostering innovation in safety by design, automation and artificial intelligence.

This report is submitted as the first part of Preliminary Report 2 – a literature review which provides an overview and synthesis of the current literature concerning the three focus areas. Findings from this report will be used to further inform the subsequent efforts of the MARS LMS, and will be included in the Preliminary Report 2B. **This report was prepared by CTWD. Chapters 1 and 3 were authored by CTWD, Chapter 2 was authored by the Curtin School of Population Health.**

The Landmark Study comprises the following reports:

Preliminary Report 1: The first preliminary report presented an assessment of the documented efforts by Australian mining companies to ensure the well-being of employees across three domains: mental health and well-being, physical health and safety, and workplace culture and sexual harassment/assault.

Preliminary Report 2A: This present report is a literature review which provides an overview and synthesis of the current literature concerning the three focus areas. Findings from this report will guide the further investigation of these focus areas.

Preliminary Report 2B: A report to establish a baseline of current practices and experiences, through: a) *a workplace policy and practices survey* that assesses the initiatives that mining companies engage in to support employee well-being, b) *an employee survey* that assesses employees' experiences in regard to the three focus areas, and c) *employee interviews* to understand the lived experiences of employees in relation to the three focus areas. Recommendations for improvement will be made based on the data.

Preliminary Report 3: This report consists of the findings from a follow-up data collection effort. The success of the initiatives implemented after the baseline data collection will be evaluated in this report.

Final Report 4: The fourth and final report will synthesise the findings and report on efforts across the four years, including but not limited to data collection efforts to track the trajectories and changes in the three focus areas over time, and including recommendations.

THE RESEARCH TEAM

This research has been led by the Centre for Transformative Work Design, Curtin University. Authors of the report are as follows:

- Dr Cheryl Yam, Lead Researcher (Centre for Transformative Work Design)
- ARC Laureate Fellow Professor Sharon Parker, Chief Investigator (Centre for Transformative Work Design)
- Dr Laura Fruhen, Principal Academic Advisor (University of Western Australia)
- Mr Martin Anderson, Collaboratory Manager (Centre for Transformative Work Design)
- Ms Giselle Woodley, Research Assistant (Collaboration for Evidence, Research and Impact in Public Health)
- Dr Jacqueline Hendriks, Researcher (Collaboration for Evidence, Research and Impact in Public Health, Curtin School of Population Health)
- Professor Sharyn Burns, Academic Advisor (Collaboration for Evidence, Research and Impact in Public Health, Curtin School of Population Health)
- Dr Cathy Drane, Researcher (Centre for Transformative Work Design)

ABOUT THE CENTRE FOR TRANSFORMATIVE WORK DESIGN

The Centre for Transformative Work Design is a Research Centre where passionate organisational psychology researchers and professionals are working together to transform work under the directorship of Australian Research Council Laureate Fellow, Professor Sharon K. Parker.

We conduct high quality, independent and innovative research to understand the role of work design in generating healthy and productive work.

We are committed to fostering the design of good work across all industries.

ABOUT THE COLLABORATION FOR EVIDENCE, RESEARCH AND IMPACT IN PUBLIC HEALTH

The Collaboration for Evidence, Research and Impact in Public Health is a multi-disciplinary centre within the Curtin School of Population Health.

Recognising the complexity of health and its determinants, our collaboration generates evidence to support action across educational, organisational, socio-economic, environmental and political domains to improve population health in our region.

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Executive summary

Purpose

This report (Preliminary Report 2A) is part of the Mental Awareness, Respect and Safety (MARS) Landmark Study (LMS).

Currently, there are gaps in knowledge specific to the mining industry regarding mental health and well-being (Chapter 1), sexual harassment, assault, and a respectful culture (Chapter 2), and the future of work (Chapter 3). As part of an investigation into these focus areas in the mining industry, this report provides a synthesis of the current research literature concerning each of these topics within the sector. Where relevant in this summary, we make reference to findings from the MARS LMS Preliminary Report 1, *Towards a healthy and safe workplace in the mining industry: A review and mapping of current practice*[1].

Key points

Findings from a comprehensive literature review on mental health in mining, based on analysis of 40 studies conducted between the years of 1998 and 2022 – with the majority of studies within the past decade – suggest that the **prevalence of poor mental health in the mining industry is high** compared to:

1) comparable norm groups (e.g., with similar industry characteristics, gender, age, location of residence, etc.), and

2) national benchmark data.

This finding is consistent with the MARS LMS Preliminary Report 1, which found that psychological distress within miners has increased in the past six years, and that the proportion of workers in mining who reported to be "very satisfied" with their jobs was the lowest compared to all other industries[1].

Findings from a comprehensive literature review on sexual harassment/assault in mining, based on analysis of 34 studies conducted between the years of 2013 and 2022, suggest that the **prevalence of sexual harassment/assault in the mining industry is high** compared to norms and national benchmarks.

We also used the literature reviews to identify the key contributing factors to mental health and sexual harassment/assault within mining workplaces. Multiple common factors underlie the focus areas of mental health, sexual harassment/assault, and the future of work in the mining industry. We developed an integrative framework of factors drawing on the literature review findings, as well as drawing on well-established theories that are applicable across various contexts[2]. Table 1 summarises the key influencing factors within the mining industry. The following themes emerged consistently across the separate literature reviews:

Theme 1. Improving work design is an effective prevention strategy

Social support at work (from colleagues and supervisors) is linked to better mental health and can counter isolation and loneliness on mine sites. Concerningly, MARS LMS Preliminary Report 1 found that mining organisations tended to report the lowest priority on initiatives targeting loneliness and social connections at work, compared

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1   Duncan, A., Kalsi, J., & Mavisakalyan, A. (2022). *Towards a healthy and safe workplace in the mining industry: A review and mapping of current practice*. Bankwest Curtin Economic Centre.

2   Parker, S. K., Van den Broeck, A., & Holman, D. (2017). Work design influences: A synthesis of multilevel factors that affect the design of jobs. *Academy of Management Annals, 11*(1), 267-308. https://doi.org/10.5465/annals.2014.0054

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to other mental health and well-being initiatives. Research from multiple sectors highlights the importance of other work design factors, such as reasonable levels of job autonomy, moderate (rather than excessive) levels of job demands, and shift/roster structures that allow sufficient opportunities for recovery.

While no studies within the mining industry explicitly linked work design to preventing sexual harassment/assault, research in general indicates that work design – especially related to social support and autonomy – is an important protective factor against bullying and sexual harassment at work.

Research suggests that, unless designed and implemented with attention to human and work issues, automation and other forms of future technology can negatively affect work design, such as reducing people's job autonomy and intensifying work.

Theme 2. A hyper-masculine culture is linked to dysfunctional behaviours

A hyper-masculine culture is one in which the work environment values the behaviours perceived to be "normal" of the traditional male gender role. There is evidence from the literature that such a culture exists within the mining sector. The following detrimental behaviours are more likely to occur in a hyper-masculine culture:

- increased stigma associated with seeking mental health support;
- unhealthy levels of alcohol use;
- sexual harassment and assault; and
- asserting power and superiority over females in order to "keep them in their place".

Traditional gendered stereotypes in the mining industry are predicted to be weakened in the future mine sites. This is likely to be a consequence of the general shift away from physical and manual labour to more technologically-assisted ways of mining.

Social support at work (from colleagues and supervisors) is linked to better mental health and can counter isolation and loneliness on mine sites.

Theme 3. Team/worksite culture is linked to well-being outcomes

Studies in mining show that a perceived culture of incivility within a team or worksite is linked to poorer mental health, as well as a higher frequency and severity of sexual violence behaviours. A culture of incivility is one which appears to tolerate disrespectful behaviours at work, such as bullying or harassment. In contrast, a perceived team/worksite culture that prioritises mental health, such as through implementing and encouraging employees to engage in mental health initiatives, is linked to better mental health outcomes for miners, such as a higher likelihood of seeking both formal and informal supports.

Teams are predicted to become more tightly networked in the future; in some cases, machines will operate akin to team members. As such, team culture will need to be proactively managed to support employee mental health, well-being, and respectful working relationships.

Theme 4. Systemic gender-based discrimination can have a cyclical effect

Studies within mining suggest that organisational sexism, such as women being overlooked for promotion or their performance being judged unfairly, results in the systemic exclusion of women from key decision-making positions. Further, organisational sexism means women in mining often do not feel they belong, resulting in poor mental health, lowered job satisfaction and increased turnover. As a result, women's input, perspectives and concerns tend to be excluded from policymaking, creating a cycle that further perpetuates organisational sexism. This finding from the literature review is in line with the findings in the MARS LMS Preliminary Report 1, that an explicit organisational commitment to having more inclusive gender representation, especially in senior management positions, is linked to employee well-being.

Perceived organisational commitment to mental health and the prevention of sexual harassment/assault is associated with better well-being outcomes amongst employees. Further, a psychosocial safety climate encourages employees to speak up with concerns.

Theme 5. When designed and implemented effectively, workplace policies and practices can support a healthy workplace now and in the future

There is generally a low awareness of policy and practices related to both mental health and sexual harassment/assault in mining. Formal workplace supports in their current form, such as Employee Assistance Programs and reporting of harassment through formal grievance processes, are less favoured by workers due to a fear of consequences for their employment and career, compared to informal support options, such as reaching out to friends and family. This latter finding aligns with the MARS LMS Preliminary Report 1 that found safe reporting systems that protect both survivor and bystander whistle-blowers are linked to employee mental health and well-being.

Theme 6. Training and education as a standalone initiative is not a panacea

Training and education initiatives have been shown to sometimes be effective in supporting workers' mental health and well-being and the prevention of sexual harassment/assault. However, these training and education initiatives must be implemented with care: initiatives that are seen as a 'tick-box exercise,' or implemented solely to address the organisation's legal obligations, tend to be less successful in improving mental health or reducing harassment and other negative behaviours. These findings are consistent with the MARS LMS Preliminary Report 1, which reported that the quality of interventions is paramount.

Moving forward

The above findings will *guide the further investigation of these topics* in the scope of the MARS LMS. For example, aspects such as work design, culture, and perceptions of training quality will be assessed further during interviews and in the survey of mining employees.

These six themes, and the more detailed research analysis that underpins them in the remainder of this report, *provide a strong evidence-based foundation to guide interventions* developed by the government, service providers, mining organisations, industry associations, unions, and other relevant stakeholders.

Table 1

Common themes identified in relation to research in the mining industry across the three literature reviews

Theme	Mental awareness	Sexual harassment/ assault	Safety in the future of mining
Work design *The content and organisation of one's work tasks, activities, relationships, and responsibilities*	• **Relational support at work** is consistently linked to better mental health and well-being outcomes, including support from colleagues and supervisors (Asare-Doku et al., 2022; Asare-Doku et al., 2021; Parker et al., 2018; Mclean, 2012).	While no papers in the current literature review explicitly mentioned work design as a contributing factor to harassment, research outside of the mining industry indicate that **relational support** from colleagues and supervisors at work is an important protective factor against bullying and sexual harassment at work (McLaughlin et al., 2012; Nielsen et al., 2019; Sigursteinsdottir & Karlsdottir, 2022). Further, evidence from studies and meta-analyses outside of the mining industry suggest that other work design characteristics such as autonomy, irregular work schedules and work demands are linked to bullying behaviours, suggesting that **good work design is an effective prevention strategy** to address harassment at work (Bowling & Beehr, 2006; Li et al., 2019; Samnani & Singh, 2012; Tuckey et al., 2021).	• Knowledge about work design can inform changes in the future of work in mining. Based on known work design principles future work can be proactively planned and developed to ensure it is efficient, motivating, and healthy for people.

Table 1

Common themes identified in relation to research in the mining industry across the three literature reviews (continued)

Theme	Mental awareness	Sexual harassment/assault	Safety in the future of mining
Masculine culture *An environment which values the behaviours perceived to be "normal" of the traditional male gender role*	• **Stigma** associated with seeking support for mental health is gendered, with females more likely to access formal and informal support, while males tend to favour informal support systems (Lifeline WA, 2013). Reluctance to seek formal support can be reduced if help-seeking behaviour is modelled by another perceived "strong" male role model (Ebert & Strehlow, 2016). *Note:* Research outside the scope of the current review also generally recognises an underreporting of mental ill-health among men as this may be perceived as less masculine and a reflection of weakness (Conway, 2000; Sigmon et al., 2005).	• The mining industry and resource extraction sector feature a prominent **'hyper-masculine'** culture (Boyer, 2017; Gilmore et al., 2016; Huggins, 2017; Kotsadam et al., 2017; Perks & Schulz, 2020; Saunders & Easteal, 2013), which has been linked to both sexual violence and alcohol use (Gilmore et al., 2016; Jenkins, 2014). • Mining is still widely considered to be 'mens work'. This perception creates an **in-group/out-group** barrier to increasing female participation where women are exposed to complex power dynamic issues (Kelly et al., 2014; Kotsadam et al., 2017; Lahiri-Dutt, 2022). • **'Performative masculinities'** can manifest as harassment and violence in an attempt to assert superiority and power over women in mining (Maqubela, 2020; Saunders & Easteal, 2013).	• The shift to more centralised operating centres away from physical mine sites may make work in mining more attractive to females. Further, the shift of a large portion of mining work to a more office-based environment may temper the 'macho-masculine' culture synonymous with the mining industry (Abrahamsson & Johansson, 2021).

Table 1

Common themes identified in relation to research in the mining industry across the three literature reviews (continued)

Theme	Mental awareness	Sexual harassment/ assault	Safety in the future of mining
Team/worksite culture *The collection of values, expectations and practices that guide and inform the behaviours and actions of team members*	• Site culture which was seen to **permit uncivil behaviours** (e.g., bullying) was linked to poorer mental health (Salas et al., 2015). • Sites that were perceived to **prioritise mental health** were also more likely to implement initiatives to address mental health, resulting in better mental health outcomes (Asare-Doku et al., 2022; Sayers et al., 2019; Tynan et al., 2018).	• Sites that were perceived by employees to endorse an **'unwritten code of silence'** and a **'culture of impunity'** regarding sexual harassment and assault, have a higher frequency and severity of sexual violence behaviours (Buss, 2018; Knapp, 2016; Lahiri-Dutt, 2022; Our Watch, 2019). • Some uncivil behaviours can become so **normalised** in the workplace that they are no longer perceived as unacceptable, to the extent that there is no reaction by, or even consequence sought by, the targets (Saunders & Easteal, 2013).	• Advancement of technology will make teams more interconnected, and operations will be more highly networked. • "Superteams" are also a future possibility, where artificial intelligence is accepted as an equal team member.
Organisational culture *The collection of values, expectations and practices that guide and inform the behaviours and actions of workers in an organisation*	• **Organisational sexism** negatively impacts mental health and job satisfaction of women through a reduced sense of belonging (Rubin et al., 2017) • Perceived **organisational commitment to mental health** was positively associated with better mental health outcomes (Considine et al., 2017; James et al., 2018; Liu et al., 2015; Yu et al., 2022).	• **Organisational sexism** means that women are less likely to fill management roles, and womens' perspectives and concerns tend to be overlooked (Hill et al., 2021; Huggins, 2017). • Anti-harassment policies with no female input and support are less relatable and effective (Saunders & Easteal, 2013; Sinclair, 2021). • Perceived **organisational and leadership commitment** to reducing sexual harassment through clear communication of policies is imperative (Knapp, 2016). • Organisations need to create a **climate of trust, reliability, and accountability**, which provides a sense of **safety** for anyone who reports sexual misconduct such as victims (i.e., a victim-centered approach) as well as any witnesses (Kansake & Sakyi-Addo, 2021).	• A positive organisational climate, including open communication and organisational trust are important factors in predicting success of technological changes (Vanhala & Ritala, 2016; Worley et al., 1999).

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Table 1

Common themes identified in relation to research in the mining industry across the three literature reviews (continued)

Theme	Mental awareness	Sexual harassment/assault	Safety in the future of mining
Workplace policies and practices *The formal and informal guidelines undertaken by organisation which express an organisation's values*	• **Awareness** of mental health support initiatives is low (Lifeline WA, 2013). • Formal supports such as EAPs tend to be less preferred options by miners than informal supports such as colleagues, friends and family (Sayers et al., 2019; Torkington et al., 2011).	• **Awareness** of and trust in reporting channels is very low (Botha, 2016; Kansake et al., 2021) • **Fear of reporting** related to the consequences to the victim also hindered access to such supports (Botha, 2016; Buss, 2018; Kansake et al., 2021). • Anti-harassment **policies need to be communicated and understood clearly**, and re-distributed regularly (Knapp, 2016). • Policies that are **transparent** are more likely to limit negative behaviours (Saunders & Easteal, 2013).	• Organisational policies can help address uncertainties related to the future of work (Avgoustaki, 2016). Such as policies should cover anticipated practices around regular analyses of risks to mental and/or physical health whenever new technical systems are introduced.
Education and training *Initiatives to support the development of workers*	• Mental health training initiatives largely focus on the **individual level** (e.g., mindfulness based stress reduction techniques), or at the **site level** (e.g., education around identifying poor mental health, training key "connectors" to support colleagues' mental health).	• Training and education need to be inclusive, explain anti-harassment policies and practices, and any consequences, **simply and clearly** (Botha, 2016; Perks & Schulz, 2020; Saunders & Easteal, 2013). • If training is perceived to be based on formal compliance, it is less likely to be successful than if employees perceive that their organisation is committed (AHRC, 2020).	• Menial tasks are likely to be automated, enriching jobs of the future. • It is unlikely that whole jobs will be automated (Parker & Grote, 2020). • Workers will need to be upskilled and reskilled to proactively prepare them to take up future roles which will be highly integrated with technology.
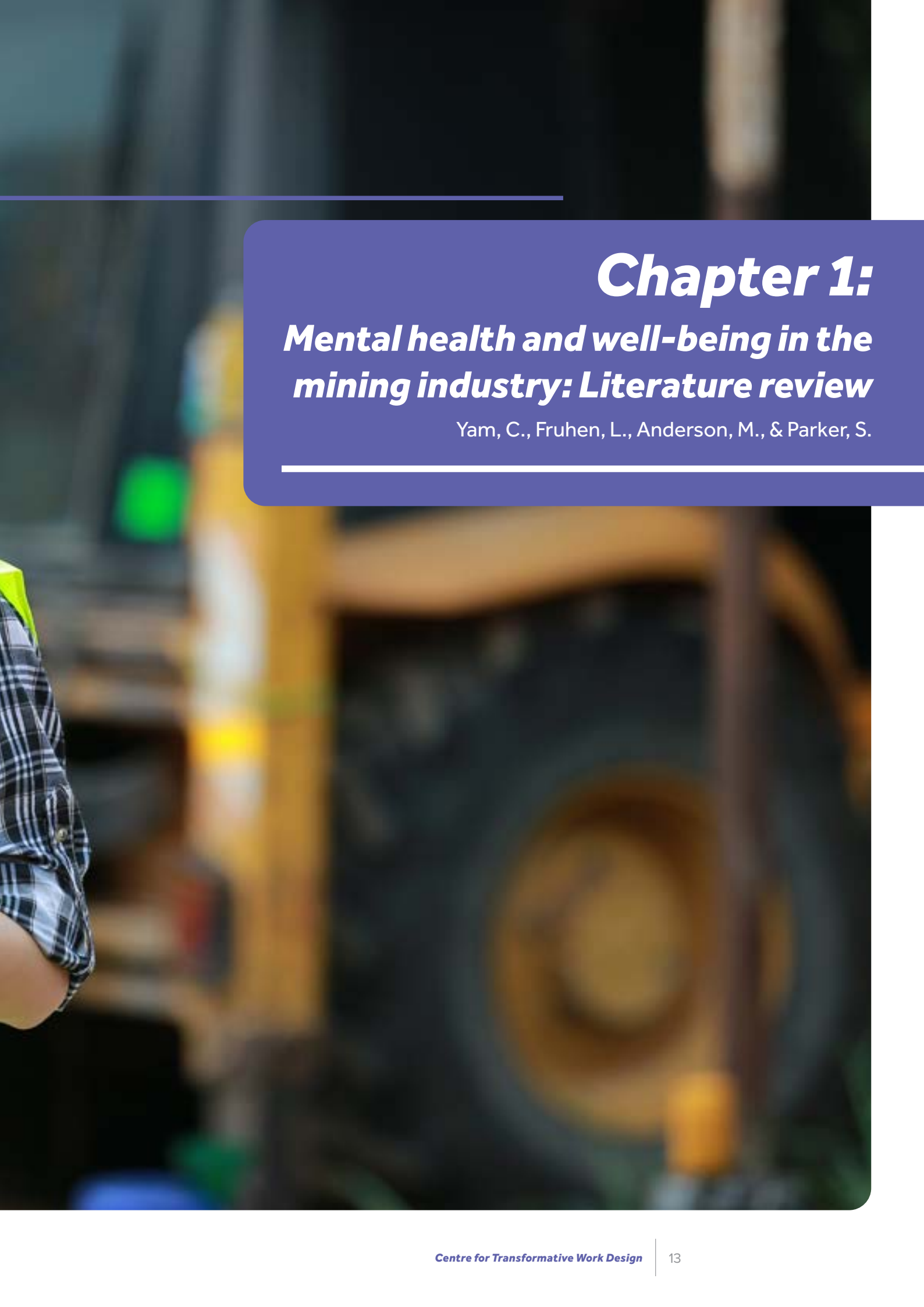
Chapter 1:
Mental health and well-being in the mining industry: Literature review

Yam, C., Fruhen, L., Anderson, M., & Parker, S.

Mental health and well-being in the mining industry: Literature review

Context and background

This literature review provides an overview of the existing research into mental health in the mining industry. Specifically, the aims of the review are to:

    a. Synthesise and analyse research findings on the state of work-related mental health and well-being in the mining industry, and

    b. Identify the key drivers of work-related mental health and well-being in the mining industry (drivers are factors that can influence an individual's level of work mental health).

Scope of analysis

According to the Australian and New Zealand Standard Industrial Classification (Australian Bureau of Statistics, 2008) Division B, the mining division "includes units that mainly extract naturally occurring mineral solids, such as coal and ores; liquid minerals, such as crude petroleum; and gases, such as natural gas. The term mining is used in the broad sense to include: underground or open cut mining; dredging; quarrying; well operations or evaporation pans; recovery from ore dumps or tailings as well as beneficiation activities (i.e. preparing, including crushing, screening, washing and flotation) and other preparation work customarily performed at the mine site, or as a part of mining activity". While the Australian and New Zealand Standard Industrial Classification definition of mining includes oil and gas, for the requirements set out by the MARS program, we limit the definition of mining to exclude oil and gas extraction.

The mining industry in Western Australia employs different types of workers. One distinct group of workers are fly-in, fly-out (FIFO), or drive-in, drive-out (DIDO) workers whose primary place of work is beyond daily commuting range of their permanent place of residence. FIFO and DIDO workers are required to travel, usually at fixed schedules, temporarily to the worksite, and are provided with accommodation and food for the duration of each "swing". FIFO and DIDO workers work on a rotational basis (Commission for Occupational Safety and Health, 2019; Parker et al., 2018). The Productivity Commission (2020) estimated that the majority of the Western Australian mining workforce worked on a FIFO basis (63%; as cited in King, 2022). However, there are other workers employed by the mining industry, such as residential miners who live within communities that reside close to mine sites. These communities have facilities typical of any residential town, such as schools, shopping centres, childcare, and recreational amenities (Zhou, 2019). Miners living in proximity to their mine sites do not face the same challenges as FIFO/DIDO miners of living on "swings" and being away from family and friends for fixed, regular periods, but may instead face unique challenges of rural living (Mclean, 2012).

Definition of key concept: Mental health

The World Health Organisation (2022) defines mental health as a *"state of well-being in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community"*. Consistent with this definition, we identify *psychological well-being* and *poor mental health* as two aspects that give a complete picture of the state of an individual's mental health in the mining industry. The dual-factor model of mental health considers not just the absence of mental ill-health (e.g., anxiety, depression, negative affect, burnout), but also the presence of positive indicators of mental health (e.g., satisfaction, engagement, thriving). Figure 1 demonstrates the mental health spectrum. An effective investigation of mental health in the mining industry

therefore needs to consider the whole spectrum of mental health, ranging from poor psychological well-being to thriving at work.

Figure 1 The overall mental health spectrum (Chen et al., 2020; Parker et al., in press)
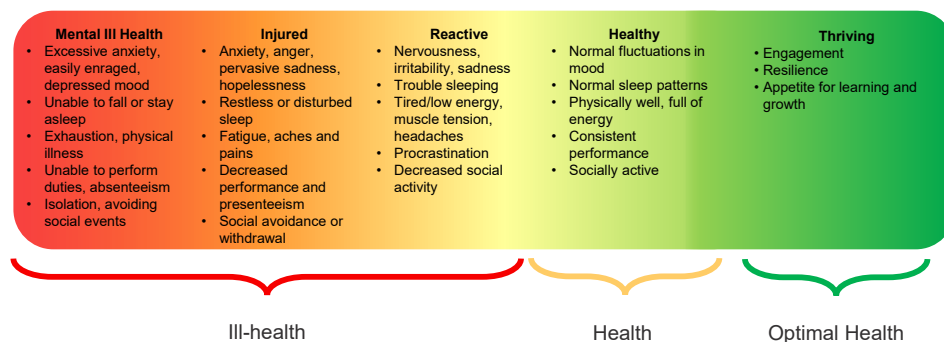
Mental ill-health can include negative markers such as burnout (a psychological state characterised by overwhelming emotional exhaustion, depersonalisation – feelings of cynicism and detachment, as well as a sense of reduced personal accomplishment; Maslach, 2016), anxiety and depression (Kessler et al., 2002). These outcomes are widely used as markers for mental ill-health, and have been identified as associated with the work environment and attributes (Parker et al., 2018). On the other hand, work-related psychological well-being includes markers such as job satisfaction, work engagement (a positive, fulfilling, work-related state of mind; Schaufeli & Bakker, 2004), and more recently, thriving (a psychological state in which individuals experience both a sense of vitality and learning; Porath et al., 2012)

Literature review: Mental health in the mining industry

A scoping literature review was conducted to gain an overview of the existing evidence concerning mental health in the mining industry. We employed a rigorous and commonly used strategy in literature reviews published in scientific research. These steps are outlined in Figure 2. The literature is divided into two parts: 1) an electronic search using databases, and 2) a hand search of material identified via other methods such as through subject matter experts, references identified in electronic search, and through a search for industry reports.

The electronic search was conducted using relevant databases which primarily index articles from peer-reviewed journals (Web of Science, Science Direct, Proquest). Next, the hand search was conducted by examining the reference lists of papers identified from the electronic search, reports identified by subject matter experts, and the results of a Google search to find additional papers or industry reports.

Figure 2 Overview of literature search steps

STEPS	METHOD	OUTPUT
Step 1	**Search of** Web of Science; Science Direct; Proquest Search term: Mining OR Mines AND Mental Health AND NOT "data mining" AND NOT "text mining"	367
Step 2	**Title Screening** Criteria: sources cover mining with focus on mental health	82
Step 3	**Removing Duplicates**	74
Step 4	**Abstract Screening** Criteria: sources cover mining with focus on mental health	43
Step 5	**Full Paper Reading** Main criteria: Source presents theory or findings from the mining industry on: 1) Workers mental health and well-being 2) Multi-level factors associated with worker mental health and wellbeing Other criteria: 1) Written in English 2) Source type: Journal papers, book chapters, conference submissions, industry and research reports	33
Step 6	**Hand Search** References identified in papers returned in electronic search Reports identified by subject matter experts Google search: "mental health mining report" → 37,500,000 results. Checked first 100 results	54
Step 7	**Removing Duplicates**	22
Step 8	**Abstract Screening** Criteria as in Step 4	10
Step 8	**Full Paper Reading** Criteria as in Step 5	7

TOTAL NUMBER OF SOURCES = 40

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In total, 40 sources that address mental health in mining were identified. The studies included interview studies (8 studies; most have samples of between 10 and 29 participants), survey studies (23 studies), quasi-experimental studies (5) and reviews (3 literature reviews and 1 state government inquiry report included a brief review of three separate studies).

The three literature reviews identified from the search were all conducted within the last 6 years (Asare-Doku et al., 2020; Langdon et al., 2016; Pizarro & Fuenzalida, 2021), demonstrating the increasing focus on mental health in the mining industry in recent times, and suggesting that this literature has become large enough to warrant overview summaries. The reviews – including the state government inquiry report – focused on various aspects of the mining industry, such as general evidence regarding the state of mental health of mine workers in Australia (Education and Health Standing Committee, 2015) and across the world (Pizarro & Fuenzalida, 2021), the impact of working arrangements on physical, mental, psychosocial and safety outcomes (Langdon et al., 2016), and mental health interventions in the mining industry (Asare-Doku et al., 2020). While these literature reviews were not included in our review (which only includes primary studies), the increasing focus on mental health in the mining industry indicates that this is an area of importance. The reference lists from these reviews were checked to ensure that relevant studies were captured in the current literature search.

The studies focus on a range of mental health and well-being attributes, ranging from poor psychological well-being to positive markers of mental health, aligning to the WHO (2022) definition of mental health. Figure 3 provides an overview of the mental health and well-being aspects covered by the studies. Most of the studies considered depression and anxiety – indicators of mental ill-health – as a marker of mental health and well-being. However, some studies used general indicators of mental health, interpersonal relationships and general well-being.

Figure 3 Overview of mental health and well-being aspects covered by the studies
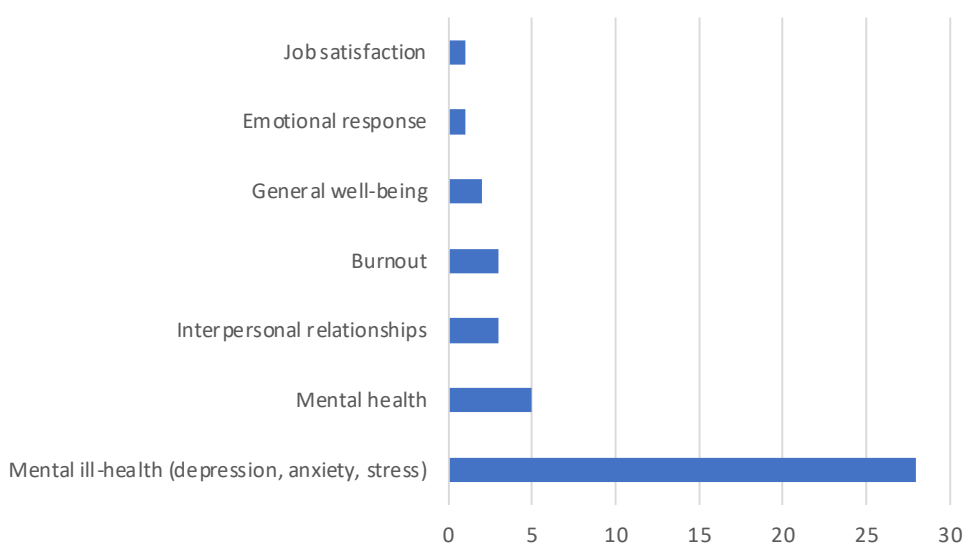
Prevalence

Overall, 18 of the studies mentioned the state of mental health in the mining industries or made comparisons with similar groups, varying across different sources such as research benchmarks (Yang et al., 2021), comparison groups from national survey benchmarks (Ahmad, 2017; Asare-Doku et al., 2021; Bowers, 2015; Considine et al., 2017; James et al., 2018; Lifeline WA, 2013; McPhedran & De Leo, 2014; Yu & Li, 2019), and samples of other professionals (Avery et al., 1998; Bowers et al., 2018; Parker et al., 2018). Of these studies, results predominantly showed that miners displayed poorer mental health.

Twelve of the 18 studies found that the sample of workers in mining were more likely to report higher levels of mental ill-health compared to other groups. Three studies compared a mining group to norm groups of similar demographics. They report that:

- Compared to a benchmark group (similar in gender and age), Parker et al. (2018) found that a sample of FIFO workers reported significantly higher levels of psychological distress (32.61% of FIFO workers indicated high or very high scores on the K10 compared to 17.21% in the benchmark group). Levels of psychological distress (F(1,398.18) = 68.25, p < .01) and burnout (F(1,372.49) = 73.58, p < .01) were found to be significantly higher in the FIFO group, in addition to lower levels of social well-being (F(1,10.36) = 6.10, p = .01).
- Compared to a sample of construction workers – also a male dominated industry –the sample of miners was 2.5 times (p < .05) more likely to experience anxiety and depression (Bowers et al., 2018).
- Compared to Australian non-miners employed in other industries but residing in the same area – thus exposed to similar communities and environments – the sample of active residential Australian miners were 3.0 times (p < .05) more likely to suffer from a psychological disorder (Avery et al., 1998).

Four studies compared a mining sample with national data from the Australian Bureau of Statistics (ABS). They found that:

- The mining sample reported significantly higher rates of psychological distress (χ^2(3) = 97.81, p < .001) compared to the general Australian population (Considine et al., 2017).
- 44.4% of Australian miners in a study sample reported moderate, high or very high levels of psychological distress. This figure was found to be significantly higher (χ^2(3) = 338.02, p < .001) than the national average of 27.2% (James et al., 2018).
- Approximately 20% of FIFO mining workers reported as likely to have a moderate or severe psychological disorder. Compared to the general population from the 2012 ABS survey, a greater likelihood of a psychological disorder incidence was found amongst FIFO workers (Lifeline WA, 2013).
- The estimated prevalence of mental distress, indicated by high and very high scores on the K10, ranged from 17.4-29% across four mine sites (Bowers, 2015). This number was significantly higher compared to the general population in the 2007 ABS Survey (9.4% of high to very high psychological distress).

Outside of Australia, three studies also compared a mining sample with other benchmarks. Similar to findings within Australian samples, a pattern of increased psychological distress was observed:

- In India, miners were found to be 2.34 times (p < .05) more likely than the comparison group (a sample of non-miners residing in the same area) to experience

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psychological distress (Ahmad, 2017). There was an additional effect of gender – in general, the prevalence of psychological distress in females was higher[1] (female miners 80%, female non-miners 52.8%; male miners 36.2%, male non-miners 13.8%).

- Using Ghana-specific mental health data published by the World Health Organisation (2011) as a comparison, 37.4% of Ghanaian miners were found to report significantly higher ($p < .01$) levels of moderate[2], high or very high levels of psychological distress compared to 13% of general working Ghanaians (Asare-Doku et al., 2021).

- Compared to national norms in China, miners scored significantly poorer on a variety of markers of mental ill-health ($p < .05$), including markers such as depression, anxiety, obsessive compulsive symptoms, and paranoia (Yu & Li, 2019).

Three studies compared the mental health of miners to general global research benchmarks for well-being. Vojnovic and Bahn (2015) measured the levels of depression, anxiety and stress symptoms amongst Western Australian FIFO workers, and found that over one-third (36%) of participants experienced levels of depression, anxiety and/or stress which were above clinical cut-off levels. That is, more than one in three FIFO miners met the clinical threshold for psychological distress. In addition, 9% experienced a combination of two of the conditions, while 12% experienced a combination of all three conditions (depression, anxiety, and stress; Vojnovic & Bahn, 2015). In a study employing a more diverse sample, Velander et al. (2010) found a similar pattern in mining workers experiencing one (17.4%), two (5.1%) or all three (4.3%) conditions (depression, anxiety, stress) beyond clinical cut-off levels. While the prevalence of clinical levels of psychological distress found in the study by Velander et al. (2010) was lower than in Vojnovic and Bahn (2015), the former noted that these numbers were still comparatively higher than the national (Australia) rural and remote figures for psychological distress.

Similarly, Yang et al. (2021) found that coal miners' reported levels of burnout were considerably worse across all facets compared to general prescribed cut-off points – miners were more emotionally exhausted (M_{miners} = 3.03, vs $M_{benchmark}$ = 2.70), reported higher levels of depersonalisation (M_{miners} = 2.34, vs $M_{benchmark}$ = 1.80), and a lowered sense of personal accomplishment (M_{miners} = 1.89, vs $M_{benchmark}$ = 3.30). Finally, a qualitative study of miners reported that they felt depression was more common in mining, and that the work itself, independent of fly-in, fly-out (FIFO) arrangements, could be draining to the extent that participants reported needing to "drag [themselves] out of bed" to get to work (Mclean, 2012, p. 129).

Two of the 18 studies identified in the review of the literature did not explicitly compare the levels of mental health of miners to any comparison group, merely describing the levels of psychological distress (Sayers et al., 2019) and burnout (Nel & Kotze, 2017) in miners. However, these findings appear to contradict the findings from the earlier studies. They report that:

- 7.3% of Australian coal miners reported high to very high levels of psychological distress[3], representing a much lower number than reported elsewhere. This level of psychological distress remained stable across 18 months (Sayers et al., 2019).

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1   In general, women are more likely to both report their experiences of, and seek support for, mental ill-health than men, however it is important to understand and recognise real gendered differences in mental health (National Mental Health Commission, 2022).

2   Psychological distress is most typically measured using the Kessler Psychological Distress Scale-10 (K10), where results are grouped into four levels of psychological distress: Low (scores of 10-15, indicating little to no distress), Moderate (scores of 16-21), High (scores of 22-29), and Very high (scores of 30-50; Australian Bureau of Statistics, 2015). Studies typically consider participants in the high to very high categories most at risk of psychological distress.

3   It should be noted that the Australian Bureau of Statistics (2018) reported a prevalence rate of 11.3% of Australian males who experienced high or very high levels of psychological distress.

- The level of burnout in a sample of South African miners was described as 'fairly low' (M = 2.263, SD = 1.37), which was contrary to the authors' hypothesis (Nel & Kotze, 2017) and findings from other studies.

Finally, two studies found no difference in, or even better, mental health in miners, compared to other groups. One study of operators from various industries (including mining) found that stress related to aspects of the job in miners was lower compared to other industries such as construction, chemicals, metal finishing and food operators. However, it should be noted that the statistical results from this specific analysis were not reported in the study (Mościcka-Teske et al., 2017).

Another study found that a sample of workers in mining was no more likely to report mental health problems compared to other groups of workers. McPhedran and De Leo (2014) used data from the Household, Income and Labour Dynamics in Australia (HILDA) survey to compare a small sample of Australian male miners (n = 66) with a sample of Australian males employed in other industries (n = 309). They found that stress resulting from relationship or family conflict in the sample of miners did not significantly differ from the comparable sample of other workers from different industries, and concluded that the results did not provide evidence for an association between employment in the resources sector with relationship or family stress. This may have in part been due to the vast improvements in communications infrastructure (e.g., video call functions, more stable networks, etc.) contributing to feelings of connectedness (Mette et al., 2019).

On the whole, these studies suggest that mental health is a topic that warrants attention within the mining industry.

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Investigating two aspects of psychological distress separately – anxiety and depressive symptoms –Joaquim et al. (2018) found that a greater proportion of workers reported feelings of mild (7.1%) or moderate (5.9%) anxiety, compared to depression (3.5% across any levels of depression)[4]. This suggests that psychological distress in miners is more likely to manifest in symptoms of anxiety. The importance of understanding the impacts of poor mental health in the mining industry was discussed by Carlisle and Parker (2014), noting that miners who reported low levels of psychological distress took fewer days off work compared to those who reported high or very high psychological distress.

Taken together, these results suggest that the mental ill-health of miners is generally higher compared to various comparison groups. It is important to note that while most studies used psychological distress or burnout as markers of mental-ill health, McPhedran and De Leo (2014) used relationship or family stress as a marker of mental health and well-being. It is possible that while miners experience higher levels of mental and emotional stress, that potential relationship or family stress may be partially "offset" by factors associated with the mining industry. For example, McPhedran and De Leo (2014) theorised that factors such as a higher average equivalised income may partially mitigate the potential negative impacts of longer working hours on stress arising from work-family conflict.

On the whole, these studies suggest that mental health is a topic that warrants attention within the mining industry. While it is important to note that the studies included in this literature review sampled various types of workers in the mining industry, including workers such as bus-in, bus-out (BIBO) and residential miners, results from the literature review are also in line with the findings from Parker et al. (2018) on the effects of FIFO work arrangements on the mental health and well-being of FIFO workers – specifically that FIFO workers experienced higher psychological distress when compared to a benchmark group. Studies included in this literature review included different proportions of FIFO/DIDO/BIBO/residential miners. While studies with larger proportions of residential miners (e.g., Ahmad, 2017; Considine et al., 2017) demonstrated similar findings to studies of FIFO/DIDO samples (e.g., Lifeline WA, 2013; Parker et al., 2018; Vojnovic & Bahn, 2015), it is not possible to definitively conclude that these findings are not confounded by the unique characteristics associated with FIFO work. Therefore, it would be important for future studies to investigate the impacts of such working arrangements on mental health.

Contributing factors: A framework of multi-level factors related to mental health in the mining industry

Findings summarised in the previous section suggest that mental health in the mining industry appears to be poor, whether compared to norm groups or clinical and research benchmarks. In order to identify reasons for these findings, the contributing factors to mental health, specific to aspects of the industry, need to be addressed. To that end, a holistic view of the mining industry needs to be considered. Many factors are likely to impact mental health in the mining industry, therefore a multi-level approach is necessary to unpack the different groups of factors involved. A framework of multi-level factors predicting mental health in the mining industry is adopted from the integrative framework of work design influences by Parker et al. (2017). This framework includes influences from different levels of a working environment, including influences at the individual level (e.g., personality, coping styles, resilience, psychological capital, etc.), the job level (e.g., work design, shifts, rosters, etc.), the local context or work group level (e.g., team interdependence, team culture, team leadership, etc.), the organisational level (e.g., HR policies and practices, organisational culture, organisational leadership, operational uncertainty, technology, etc.), and higher-level external influences (e.g., occupational, industrial, national, global factors).

In this review, we provide an overview of the types of psychological concepts and workplace attributes in the mining industry that have been considered in the research literature within each of the multi-level factors. Doing so provides a structured overview of the state of knowledge in research into the relationships between specific attributes of mining work with mental health outcomes.

Individual influences

Individual influences refer to the differences and variations between individuals in regard to their personality, traits or characteristics (American Psychological Association, n.d.). These unique characteristics influence how different people may process environments and stressors differently. Within this literature review, individual influences identified as relevant in the mining context include psychological capital (Joaquim et al., 2018; Liu et al., 2015; Nel & Kotze, 2017; Yu & Li, 2020) and coping strategies (Mclean, 2012; Molek-Winiarska & Żołnierczyk-Zreda, 2018; Nel & Kotze, 2017).

Psychological capital. Four studies investigated the effect of psychological capital (PsyCap) on mental health in the mining industry. The concept of PsyCap refers to an individual's positive psychological state that encompasses four facets – self-efficacy, optimism, hope and resilience – and has been linked to employee attitudes, behaviour and performance (Newman et al., 2014). Nel and Kotze (2017) found that miners reported high levels of PsyCap across all four facets, and that this elevated level of PsyCap was negatively correlated with burnout ($r = -.15 - -.27$, $p < .01$). Further, they also found that the specific facet of hope was a significant predictor of burnout ($\beta = -0.19$, $p < .01$), such that an individual with higher levels of PsyCap hope was less likely to experience burnout. Joaquim et al. (2018) found that PsyCap positively correlated with quality of life ($r = .28$, $p < .001$) and negatively correlated with miners' anxiety ($r = -.28$, $p < .001$). Similarly, Yu and Li (2020) investigated the effects of PsyCap on a number of outcomes, and found that PsyCap negatively correlated with work family conflict ($r = -.17$, $p < .01$), anxiety ($r = -.19$, $p < .01$) and depressive symptoms ($r = -.16$, $p < .05$).

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Two of the five studies investigating PsyCap further theorised that PsyCap could moderate, or buffer, the effects of external influences on an individual miner's mental health. For example, Yu and Li (2020) found that the negative effect of work-family conflict on anxiety ($\Delta r^2 = .03$, $p < .01$) and depressive symptoms ($\Delta r^2 = .05$, $p < .05$) was weaker in individuals with higher PsyCap. In other words, PsyCap was a psychological resource that miners could tap into to buffer the negative effects of work-family conflict on their own mental health (Yu & Li, 2020). Similarly, Liu et al. (2015) found that PsyCap was positively correlated with an individual's perceived organisational support ($r = .46$, $p < .01$), and negatively correlated with anxiety ($r = -.30$, $p < .01$) and depressive symptoms ($r = -.41$, $p < .01$). Further, the effect of perceived organisational support on anxiety ($\Delta r^2 = .010$, $p < .01$) and depressive ($\Delta r^2 = .003$, $p < .01$) symptoms was weaker in individuals with high PsyCap, suggesting that individuals with high PsyCap were less likely to be negatively impacted by a perceived lack of organisational support. Taken together, these studies suggest that within miners, the individual factor of PsyCap is not only directly related to mental health, but can also act as a buffer to reduce the effects of external influences such as job demands (work-family conflict; Yu & Li, 2020) and perceived lack of job resources (organisational support; Liu et al., 2015).

Coping strategies. Four papers investigated individual coping strategies of miners. Coping refers to the intrapersonal process of attempting to manage stressful situations or environments, such that a person is able to "manage, master, tolerate, reduce, or minimise demands" arising from the stressful environment (Taylor & Stanton, 2007, p. 378). In a qualitative study, Mclean (2012) explored through semi-structured interviews the various aspects of mental health and sources of stress in a sample of miners. In those interviews, the theme of miners' attitudes towards mental health was discussed, where participants discussed their attitudes towards personal positive coping mechanisms for coping with stressors and highlighted the importance of having healthy coping styles to manage depressive symptoms and enhance mental health in the mine. Parker et al. (2018) found that healthier coping styles (e.g., seeking support and detachment) was linked to lower psychological distress scores ($\beta_{\text{seeking support}} = -.08$, $p < .01$; $\beta_{\text{detachment}} = -.16$, $p < .01$) and higher well-being scores ($\beta_{\text{seeking support}} = .18\text{-}.23$, $p < .01$; $\beta_{\text{detachment}} = -.09\text{-}.14$, $p < .01$. Less conducive coping styles included distraction and disengagement, such that both were linked to higher psychological distress ($\beta_{\text{distraction}} = .10$, $p < .01$; $\beta_{\text{disengagement}} = .32$, $p < .01$) and burnout ($\beta_{\text{distraction}} = .09$, $p < .01$; $\beta_{\text{disengagement}} = .18$, $p < .01$), and lower levels of well-being ($\beta_{\text{distraction}} = -.09$, $p < .01$; $\beta_{\text{disengagement}} = -.14\text{-} -.24$, $p < .01$).

Two further studies investigated the effects of mindfulness on stress reduction (Molek-Winiarska & Żołnierczyk-Zreda, 2018) and burnout (Nel & Kotze, 2017). In a cross-sectional study conducted by Nel and Kotze (2017), miners reported high levels of mindfulness ($M = 5.24$, range $= 1 - 6$), and that mindfulness had a strong influence on miners' burnout, explaining 25% of the variance in burnout. In a quasi-experimental study using a mindfulness-based stress reduction intervention, Molek-Winiarska and Żołnierczyk-Zreda (2018) found that the group who underwent the mindfulness training program reported decreased anxiety ($F(1, 62) = 5.28$, $p < 0.05$) and depression ($F(1, 62) = 3.95$, $p < 0.05$) compared to the control group which did not undergo any training. The authors suggested that the effectiveness of the intervention was due to participants learning to identify their reactions to work stress and modify their response patterns to manage those stressful triggers in a more constructive manner (Molek-Winiarska & Żołnierczyk-Zreda, 2018). These three studies suggest that coping methods employed by miners to deal with stress are an important aspect in protecting the mental health of miners.

While the abovementioned studies demonstrate that research in mining has in particular focused on two areas – PsyCap and coping – there are other individual characteristics that can influence mental health, such as recovery. Recovery refers to the process of reducing or eliminating symptoms of strain during non-work time (Sonnentag & Fritz, 2015). In an industry largely characterised by shift work, different rosters, and (particularly for FIFO/DIDO workers) 'liminal time', where work and life spheres can be ambiguous, and transitions between work and non-work on swings can be institutionalised to some degree (Dorow & Jean, 2022), dedicating time and space for recovery in camp (for FIFO/DIDO workers) or at home (for residential workers) becomes even more important. This is in line with the recommendations from the report on FIFO mental health by Parker et al. (2018), which suggested that rosters should provide sufficient time to recover during periods of R&R (rest and recuperation).

Job level influences

Core to any job is the actual design of the work that employees carry out. In the mining context, jobs can be characterised by generally established work design principles, such as support, autonomy, or workload. In some instances though, miners are exposed to work design factors that are unique and largely represented in rosters and shift work. To comprehensively understand the role of work design for workers' mental health, it is therefore important to consider the effects of such specific influences at the job level on worker mental health, alongside other established work design factors. Research investigating job level influences include factors such as rosters (Bowers et al., 2018; Mclean, 2012; Parker et al., 2018), shifts (Asare-Doku et al., 2021; Considine et al., 2017; James et al., 2018; Mclean, 2012; Tian et al., 2022), job role (Carlisle & Parker, 2014; Considine et al., 2017), job insecurity (Considine et al., 2017; James et al., 2018; Salas et al., 2015; Tynan et al., 2016), and various aspects of work design (Asare-Doku et al., 2022; Asare-Doku et al., 2021; Considine et al., 2017; Mclean, 2012; Mościcka-Teske et al., 2017; Yu & Li, 2020).

Rosters and shift work. Eight studies refer to rosters and shift work. On the whole, Parker et al. (2018) found that regular and day shifts and shorter and even-time rosters were significant predictors of better mental health in FIFO workers. In a separate qualitative study, participants (residential miners) shared that the way that their work was scheduled allowed them to spend more time with friends and family during time off work (Mclean, 2012). Further, Lifeline WA (2013) found a higher prevalence of FIFO workers on higher compression rosters in the "likely to have a severe disorder" group, based on their K10 scores. Investigating stress as an indicator of well-being, Lifeline WA (2013) also found that FIFO workers on low compression rosters reported lower mean stress levels. In contrast to these three studies, Bowers et al. (2018) found that psychological distress was higher in miners on shorter and even-time rosters. Miners on 4 weeks on/1 week off rosters appeared to report the lowest prevalence of high or very high psychological distress, compared to miners on 1 week on/1 week off (OR = 1.6, $p < .05$) and 2 weeks on/1 week off (OR = 2.4, $p < .01$). The authors attributed this divergent finding to a difference in sample, where their sample included an increased representation of underground miners. Therefore, there may perhaps exist a difference in underground and other miners that research has yet to explore.

There appears to be mixed sentiments regarding the ways in which shifts were organised. In a qualitative study, night shift workers mentioned that their shifts ended before daybreak which they noticed contributed to better sleep quality, while one other participant provided an anecdotal observation that shift work was negatively impacting their well-being (Mclean, 2012). In a study of the effect of shift work on

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physical brain activation, functional connectivity in the brain's prefrontal cortex declined after workers in coal production completed a morning or afternoon shift, with greater decline observed in afternoon shift workers (Tian et al., 2022). The prefrontal cortex is the area of the brain that plays a central role in cognitive control functions, including complex cognitive abilities, emotional control, concentration, and multitasking (Tian et al., 2022). In contrast, and contrary to previous research, night shift workers (repair and maintenance in the coal mine) exhibited greater prefrontal cortex activation after completing their night shifts. Tian et al. (2022) suggested that these findings may be due to the occupation or role, rather than the effect of shift work. Specific to shift length, Asare-Doku et al. (2021) and James et al. (2018) both found that participants working on shifts that were 12 hours or longer were more likely to report moderate to high scores on psychological distress. Contrary to these three studies, Considine et al. (2017) found that work schedule (regular vs rotating shifts ; $\beta = 0.01$, $p > .05$) and commute type (FIFO/DIDO vs residential status; $\beta = -0.02$, $p > .05$) were not unique predictors of psychological distress vis-à-vis other work-related demographics (e.g., tenure, mine type, etc.).

Job role/occupation. Two studies suggested that the role of occupation itself may contribute to a miner's mental health. In one study comparing four groups of workers in a mining operation, operators/truck drivers reported significantly more psychological distress ($F(3, 209) = 6.04$, $p < .01$) than other occupational groups within mining included in the study, such as maintenance workers/electricians/mechanics / fitters and supervisors/professionals/administrative staff, but not drilling and blasting (Carlisle & Parker, 2014). In a separate study, Considine et al. (2017) found that being in a managerial position was a unique predictor ($\beta = .07$, $p < .01$) to reporting greater psychological distress when considering other work-related demographics (e.g., tenure, mine type, etc.) at the same time.

Job insecurity. Job insecurity was also a factor influencing mental health investigated by four studies. Considine et al. (2017) and James et al. (2018) both found that job insecurity was a significant predictor of psychological distress. Another study found that mine workers who were concerned about losing their jobs were significantly more likely to access professional services, suggesting that job insecurity may contribute to significant mental stress on employees (Tynan et al., 2016). On the contrary, Salas et al. (2015) found that while only a third of the sample considered themselves having job security, that job security had no effect on psychological distress (p^2_χ Monte Carlo = .13), even when differences in countries were considered. In a recent meta-analysis, Kim and von dem Knesebeck (2016) found that perceived job insecurity was related to a higher risk of depressive symptoms, providing support for the findings by Considine et al. (2017), James et al. (2018) and Tynan et al. (2016). While all three studies included both residential and commuting (FIFO/DIDO) workers, the proportion of residential to commuting (FIFO/DIDO) miners was higher in both studies which concluded that job insecurity is associated with mental ill-health (Considine et al., 2017; Tynan et al., 2016). While the relationship between job insecurity and mental health in the mining industry is inconclusive at this stage, there is a possibility that other characteristics of the job may buffer the negative effects of job insecurity on mental health.

Work design. Beyond shift and roster design or the occupation itself, how jobs are designed on the whole is key to understanding their impact on workers. Work design refers to "the content and organising of tasks, activities, relationships, and responsibilities within a job or role, or set of jobs/roles" (Parker, 2014). It includes resources – aspects such a sense of control over when, where or how a task is completed, how stimulating a job is, what and how to achieve the objectives at work, social support from colleagues and supervisors – as well as demands and strain that the job itself places on the worker. Seven studies discussed the effect of work design.

Five studies focused on specific aspects of work design, including social support (Asare-Doku et al., 2022; Asare-Doku et al., 2021; Mclean, 2012; Parker et al., 2018), skill utilisation (Asare-Doku et al., 2021; Mclean, 2012) and perceived autonomy and workload (Parker et al., 2018). Participants in two separate qualitative studies expressed that they appreciated informal conversations with their supervisors (Asare-Doku et al., 2022) and colleagues (Mclean, 2012) about their well-being. Specifically, developing feelings of camaraderie and group dynamics were identified as an important aspect of miners' mental health, as colleagues would notice any changes in behaviour and the camaraderie meant that colleagues felt comfortable to ask about their mental states or support them in more subtle ways. In that way, miners appreciated that these relational supports at work meant the people looked out for one another, not only in terms of physical safety, but also mental health and well-being (Mclean, 2012). This is in line with findings from Parker et al. (2018), where social support from supervisors and colleagues were negatively linked to mental ill-health (β = -.17 – -.28, $p < .01$) and positively linked to mental well-being (β = .14-.31, $p < .01$). Parker et al. (2018) further found that the perception of autonomy during time off and on site was negatively linked to psychological distress (β = -.10, $p < .01$) and burnout (β = -.07, $p < .01$). Workload was also linked to psychological distress (β = .16, p < .01) and burnout (β = .30, $p < .01$). Asare-Doku et al. (2021) found that social support (OR = 0.53, $p < .01$), discretion over skills used (OR = 0.61, $p < .01$), interest and skill utilisation (OR = 0.29, $p < .01$) and ability utilisation (OR = 0.53, $p < .01$), were all associated with lower odds of psychological distress. The work characteristic aspect of skill utilisation was also echoed in the qualitative study by (Mclean, 2012), with truck drivers specifically emphasising that they felt the need to find a way to keep their brains busy while on the job to make the job more bearable.

Three studies considered the balance between job resources or control with demands of the work. In studying the mitigating effects of job resources on job demands, Salas et al. (2015) found that miners who considered their jobs more demanding reported higher levels of psychological distress, and workers who had more demands than resources at work were 7.19 times ($p < .05$) more likely to experience psychological distress compared to workers who had more resources than demands at work. Further, those who also experienced high social support at work in the face of higher work demands reported lower levels of psychological distress (Salas et al., 2015). Similarly, Mościcka-Teske et al. (2017) concluded that mental strain in miners was reported to be lower (compared to other industries) because of greater interpersonal relationships at work. While Considine et al. (2017) did not include social support at work as a resource, they found that even when job demands exceeded control, no association with psychological distress was found, this imbalance may have been mitigated by other resources such as higher rewards.

Taken together, these findings suggest that while job demands have negative impacts on mental health and well-being, job resources such as social support, or less likely, renumeration, at work can help workers to meet the demands of their work, thereby reducing the negative effects of work demands.

Local context (work group) influences

The local context, site, or work group level can also have implications for an individual's mental health. The local context investigated by studies in the literature search mostly referred to team/site culture (Asare-Doku et al., 2022; Ebert & Strehlow, 2016; Salas et al., 2015; Sayers et al., 2019; Torkington et al., 2011) and team leadership (Asare-Doku et al., 2021).

Team/worksite culture. Five studies investigated the relationship between team/site culture on worker mental health and well-being. Two studies mentioned aspects of site culture including a culture of perceived stigma and fear of loss of employment as a result of seeking support, leading to a general reluctance to discuss mental health issues or seek support for mental health (Torkington et al., 2011). In a separate study, Salas et al. (2015) investigated the effect of workplace violence, harassment (including sexual harassment) and bullying, and found that experiences of workplace violence contributed to increased odds of psychological distress (OR = 1.86, $p < .05$).

Four studies indicated that initiatives undertaken at the site level had positive impacts on worker mental health. One initiative investigated was the sitewide implementation of a mental health support program ("Mates in Mining"; Sayers et al., 2019; Tynan et al., 2018). Compared to control sites, the mine sites that implemented the Mates in Mining program saw a significant increase in confidence of miners to start conversations about mental health with colleagues they were concerned about (Tynan et al., 2018), as well as the likelihood of employees seeking help from colleagues, supervisors, and EAPs (Sayers et al., 2019). This effect was even more pronounced in workers on rotating shifts (OR = 1.08, $p < .05$; Sayers et al., 2019). Another site-based initiative explored in the literature was the presence of an on-site chaplain (Ebert & Strehlow, 2016). Interviews with employees revealed that the presence of chaplains on sites were invaluable – chaplains served as another source of social support, where they were seen as a trustworthy third party who could provide an objective listening ear to offload without any of the perceived barriers and stigma associated with discussing mental health at work (Ebert & Strehlow, 2016). The final site-based initiative covered in the literature search included personal development programs organised by the sites, such as financial literacy programs, which miners discussed as being drivers of mental health (Asare-Doku et al., 2022). Further, this appeared to be a result of

site-specific cultures. Across different mine sites, participants reported that some sites prioritised worker mental health more than others, which in turn resulted in the types of initiatives implemented by each site (Asare-Doku et al., 2022).

These findings suggest that while the team or site culture can have significant effects on workers' mental health, specific initiatives implemented at the site level can help to change the team/site culture, resulting in improved mental health and well-being.

Team leadership. One study investigated the effect of team leadership on worker mental health (Asare-Doku et al., 2021). Satisfaction with the leadership of the section was found to be a significant predictor of psychological distress – workers who were satisfied with the way their section was being led were less likely to report psychological distress (OR = 0.44, p < .01).

Taken together, these findings at the work group level suggest that both the culture and leadership at the individual worksites are important factors that can contribute to employee mental health and well-being.

Organisational influences

Organisational influences refer to factors shaped and implemented at the organisational level, such as HR policies, organisational culture, and psychological safety climate.

Workplace policies. Perhaps the most commonly discussed mental health related workplace policy is the use of Employee Assistance Programs (EAPs). Indeed, three studies in our literature search made reference to EAPs (Lifeline WA, 2013; Sayers et al., 2019; Torkington et al., 2011). One study found that 7.9% of FIFO workers reported that they did not have an EAP and, and 17.2-17.5% reported that there were no on-site mental health or counselling facilities to support their mental health, suggesting that organisations needed to be more proactive in increasing visibility of such services (Lifeline WA, 2013). However, mental health supports such as EAPs appeared to be less preferred by miners in favour of colleagues, family and friends (Sayers et al., 2019; Torkington et al., 2011). In addition, one study found that perceptions of mental health workplace policy has no association with employee psychological distress (Asare-Doku et al., 2021).

Organisational culture. Perceptions that organisations were not committed to or did not value the mental health and well-being of employees were found to be significantly associated with higher levels of psychological distress (Considine et al., 2017), while perceptions of organisational commitment to and value of mental health was associated with decreased odds of psychological distress (James et al., 2018; Liu et al., 2015). In a cross-level study, Yu et al. (2022) found support for the link between psychosocial safety climate and mental health. They found that an organisation's psychosocial safety climate led to workers' perceptions of organisational support for their mental health, which then led to better mental health. More distally, this improvement of mental health as a result of increased psychosocial safety climate in turn led to an increase in safety behaviours.

Another aspect of organisational culture is organisational sexism. This refers to gender-based workplace issues, specifically at the organisational level, and includes issues such as systemically fewer opportunities for promotion, training and stability, being judged at different standards, and poorer work-life balance compared to male co-workers (Ciftci et al., 2020). Specific to mental health outcomes, organisational sexism was found to negatively impact mental health problems and job satisfaction (Rubin et al., 2017) through causing females to feel less accepted by and a reduced sense of belonging to their organisation.

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Taken together, the culture of an organisation is multi-faceted, yet has important implications for employee mental health, and potentially can also lead to improved safety on the mine site.

Higher-level external influences

Two studies investigated the mental health of miners compared across countries, suggesting that there are higher level global factors influencing mental health in the mining industry. In a multi-country study (including Bolivia, Chile and Peru), Salas et al. (2015) found that while the overall prevalence of psychological distress was 43% across all miners in their study, the actual percentages varied significantly ($p2_\chi$ Monte Carlo < .001) across countries. For example, more than 80% of miners from Bolivia reported high to very high psychological distress, compared to 22% of miners from Chile. However, these differences may in part have been influenced by occupational, rather than geographical or national factor. All miners from the Bolivian sample worked as operators, while miners in the Chilean sample included more highly skilled workers and drivers. In a separate study comparing an Australian sample with a group of miners from other countries, Rubin et al. (2017) found that female miners in Australia reported significantly fewer mental health issues in comparison to a comparison group of miners from Africa, South America and South East Asia (t(214) = -3.22, p = .001). Two other qualitative studies made mention of how there was a general reluctance to seek support or discuss mental health issues due to culture (Asare-Doku et al., 2022; Torkington et al., 2011). Together, these studies suggest that there are higher level cultural and global factors that influence mental health in the mining industry.

Additional topics that emerged from the literature search

Help seeking behaviours. Help seeking behaviours are inextricably linked to stigmatisation of mental health issues, with stigma contributing to a general reluctance to seek help. Stigma generally refers to the endorsement of prejudice or negative emotions and consequences against a member of a group (Corrigan, 2000). Specific to mental health, perceived stigma refers to concerns that one will face negative consequences such as embarrassment, discrimination, or even being penalised at their workplaces and in their careers in response to them seeking mental health supports (Corrigan, 2000).

In a qualitative study, Torkington et al. (2011) found that there was a general reluctance to seek mental health supports due to embarrassment. Further, interviews with miners demonstrated a marked lack of insight into their own mental health, which may be a contributing factor to seeking help. This lack of insight into one's own mental health was also observed in a study by the Australasian Centre for Rural and Remote Mental Health (Bowers, 2015), where miners' self-assessed mental health was found to be generally under-reported by an average of 11.4% when compared to more objective assessments of mental health such as the K10. Help seeking behaviours also appeared to be a function of gender, with females more likely to access both formal (e.g., EAPs, on-site mental health services, speaking to supervisors) and informal (e.g., support from friends and family) mental health supports, and males more likely to access informal (e.g., friends) support systems (Lifeline WA, 2013). In line with these findings, a qualitative study by the Hunter Institute of Mental Health (2016) found that the main barriers to accessing mental health services were stigma associated with mental health issues, the perceived risks associated with a potential lack of confidentiality within the mining community and a general lack of awareness around the types and availability of support. A parliamentary inquiry commissioned by the Parliament of Western Australia (Education and Health Standing Committee, 2015)

concluded that "there still remains a reluctance amongst (FIFO) workers to 'put their hand up' and seek help for their issues" (p. 73).

On the contrary, Tynan et al. (2018) found that mental health help-seeking behaviours in the mining industry were 'considerably higher' than national community estimates using data from the Australian National Survey of Mental Health and Well-being. The authors indicated that contrary to expectations, the overall proportion of participants who reported reaching out to a *professional* mental health service such as their general practitioner was almost double the national estimate of 11.9%. Using the same sample, Tynan et al. (2016) found that 46.6% of all participants in their study reported that they made contact with at least one source of professional or non-professional support to discuss their own mental health within the past 12 months. Non-professional contacts – specifically family and friends – were the most commonly identified source of mental health support. Of participants who reported seeking professional support, the majority had contacted their general practitioner as a source of support. The authors suggest that this finding may be due the support of a general practitioner not carrying the same level of stigma as more specialised mental health support services. Further, satisfaction with work was significantly and negatively associated with contacting professional sources of support. Based on a further analysis to estimate the proportion of individuals who needed mental health support services[5], 50.3% of those in the high predicted needs category for professional services had not indeed contacted a professional support service in the preceding 12 months (Tynan et al., 2016). However, the analyses from both studies included all participants reporting low, moderate and high to very high levels of psychological distress.

Comparing miners who report higher levels of psychological distress to those with low levels of psychological distress, Sayers et al. (2019) found that participants reporting high to very high psychological distress were less likely to seek help. This was consistent across professional and non-professional sources of support where participants reporting higher levels of psychological distress also reported a decreased likelihood of seeking support from family, friends or colleagues (OR = 0.30, 95%CI [0.20, 0.44]), professional sources (OR = 0.42, 95%CI [0.29, 0.60]), and their supervisors or Mates-in-Mining Connector (OR = 0.36, 95%CI [0.25, 0.51]). However, after implementing the Mates in Mining intervention, Sayers et al. (2019) found that worksites which implemented a culture supporting mental health saw a significant increase in workers' likelihoods to seek support from a family member, friend, or psychologist ($p < .05$).

Alcohol and drug use. Parker et al. (2018) identified that FIFO workers in the mining industry were more likely to use alcohol and other drugs at a riskier level compared to other groups. One qualitative study explored this phenomenon through interviews and identified that the drinking culture was so prevalent because "… The non-drinkers don't fit in as well… If you weren't in the drinking culture there wasn't much else socially. The bar was the place and that was it" (Torkington et al., 2011, p. 138). Shift work also appeared to predict harmful drinking behaviours – workers on rotating shifts and shifts of 12 hours or greater were significantly more likely to engage in harmful drinking (James et al., 2018).

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5 The Predicted Service Need Index (PSNI) is an aggregate score calculated by the authors which takes into account a combination of health status measures including psychological distress, self-rated physical and mental health, the Alcohol Use Disorders Identification Test a measure of problematic alcohol use (Tynan et al., 2016).

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The association between risky alcohol consumption and mental health was also identified by two studies in this review:

- One study found that in general, a third of all miners of both genders (M = 29.8%, F = 30.7%) reported consuming alcohol regularly, at least 2-3 times per week (James et al., 2021). Gender appeared to be a significant factor in risky drinking – males were almost three times more likely to engage in risky drinking than females (OR = 2.70, $p < .05$). A previous history of psychological distress (OR = 1.36, $p < .05$), and current experience of psychological distress (OR = 1.41, $p < .05$) were both associated with increased odds of current risky drinking.

- A history of problematic drug or alcohol use was associated with more than double the odds of reporting high or very high scores on current psychological distress, while current risky drinking (OR = 1.49, $p < .05$) and drug (OR = 2.07, $p < .05$) use were also associated with increased odds of reporting high or very high psychological distress (James et al., 2018).

These studies suggest that in addition to the co-existence of mental ill-health and risky alcohol and drug use, there may be a reciprocal association between these variables. These relationships are not unique to the mining industry – research has demonstrated a person who engages in risky alcohol and drug behaviours is more likely to develop a mental health condition, and reciprocally, a person with a mental health condition is also more likely to develop alcohol and drug dependence (Crum et al., 2013; Hall et al., 2009).

Summary

In this literature review, we aimed to summarise research findings on the state of mental health and well-being in the mining industry, and to identify the drivers which contribute to mental health and well-being in the mining industry. We identified 40 research articles and reports that met the review criteria and which pertained to the questions raised. Although there are some mixed findings, *studies predominantly show that workers in the mining industry tend to report poorer mental health and well-being on the whole, as well as in comparison to other groups.* While there has been a greater focus on mental health in mining in recent years, a number of studies are exploratory and qualitative in nature.

In order to investigate the specific aspects of work in the mining industry that contribute to mental ill-health and well-being, we employed a holistic view of the worker in a complex environment. Using a framework of multi-level factors, we identified that antecedents at various levels should be considered as drivers of mental health and well-being in the mining industry. The work environment is complex and interdependent. To improve the mental health and well-being of the mining industry on the whole, many factors need to be considered and acted upon in tandem, such as at the individual, job, site, organisational and policy levels.

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Chapter 2:
Sexual harassment in the mining industry: Literature review

Woodley, G., Hendriks, J., Burns, S., Yam, C., Fruhen, L., Parker, S., & Drane, C.

Sexual harassment in the mining industry: Literature review

Context and background

There are concerns regarding the pervasiveness of sexual harassment across all industries, and at all levels, in Australian workplaces. Australians are impacted by the financial, social, emotional, physical, and psychological harm associated with sexual harassment. Importantly, male-dominated industries, including the mining sector, experience harassment at disproportionate levels, placing workers at higher risk (Australian Human Rights Commission, 2020).

As a result of the concerns, the Australian Human Rights Commission was tasked to undertake an inquiry into Sexual Harassment in Australian Workplaces. The report, *Respect@Work*, outlines the Commission's findings and recommendations. One such finding is that one in three people (33%) have experienced sexual harassment at work in the last five years across all industries. The Respect@Work report clearly demonstrated that additional research is required to better understand the prevalence and contributing factors that drive sexual harassment in the mining sector (Australian Human Rights Commission, 2020).

Following this report, the Western Australian (WA) Parliament's Community Development and Justice Standing Committee initiated an inquiry into sexual harassment against women working in WA's FIFO mining industry. The Committee's report *Enough is enough: Sexual harassment against women in the FIFO mining industry* highlights the systemic failures within the mining industry and the need for change at the company, industry, regulatory and legislative levels (Legislative Assembly Community Development Justice Standing Committee, 2022).

This current literature review seeks to understand pre-existing research concerning sexual harassment in the mining sector, at both a global and national level. While the focus of this review is on sexual harassment within the *workplace*, it is imperative that the impact on regional centres and workers home communities is also considered. Sexual harassment has a pervasive nature where impacts are far-reaching and affect local communities in which workers live (Jenkins, 2014). The authors understand that the dynamics and contexts of mining communities vary between and within countries, regions, mines, and cultures (Bashwira et al., 2014). It is acknowledged there is merit in associated global research and findings that are relevant locally, despite differing cultural contexts and history.

Sexual harassment terminology

Prior to outlining the research method and findings related to this literature review, it is important to first consider the various terms that may be used by groups across different policy, legislative, service provision and research contexts. As there is no single nationally or internationally agreed definition of sexual harassment, different terms may be used, and some will be applied interchangeably within a particular document. The following provides definitions of key terms used in this review.

Sexual harassment is the dominant term used to refer to 'unwelcome physical, verbal or non-verbal conduct' and can include behaviours such as touching, fondling, brushing up against someone, unwelcome innuendos, commentary with sexual undertones, whistling, staring, sending messages or images of a sexual nature or sexual stories and jokes (Botha, 2016; Rubin et al., 2017). Unwanted conduct of a sexual nature can include sexual assault or rape; however, the term sexual harassment is not traditionally thought of as such and does not necessarily acknowledge the scope of behaviours that traditionally fall under the umbrella of terms such as 'sexual violence'. Criticisms of the term sexual harassment posit that the term is vague and is more associated with crude remarks, sexual suggestions, and misogynistic behaviours (Botha, 2016; Rubin et al., 2017).

While sexual harassment is the predominant term utilised in this scoping review, several of the documents cited in this review, and the terminology used in the national inquiry (Australian Human Rights Commission, 2020), use the term *sexual violence*. Sexual violence is a more expansive term that can include behaviours such as sexual harassment, stalking, sexual exploitation, indecent assault, or rape (Australian Bureau of Statistics, 2018). Similarly, other terms such as *Gender-based Violence (GBV), Sexual and Gender-based Violence (SGBV), violence against women, violence against women and children, and family and domestic violence* may also be used.

Various documents also use the terms women and gender. Characteristically, these two terms can be used synonymously (Lahiri-Dutt, 2022). However, it is important to acknowledge that issues such as sexual harassment and sexual violence do not occur solely to women or those who identity as female (Australian Bureau of Statistics, 2016).

Throughout this literature review, the specific terms used by the primary source have been replicated when presenting the findings, to provide an accurate representation of the research explored.

Literature search method

A scoping literature review was utilised to identify key concepts relating to sexual harassment in the mining industry, answer specific research questions and ascertain gaps in the available research. This is the first scoping literature review in relation to sexual harassment in the mining industry that we are aware of.

The scoping literature review was governed by the following research questions:

RQ1. What are the perceptions, prevalence and contributing factors to sexual harassment in the mining industry?

RQ2. Which strategies and interventions have been implemented to reduce sexual harassment and what is their effectiveness?

RQ3. How can previous and developing research contribute to understandings and future implementations?

A preliminary search of databases was conducted to confirm the most appropriate search terms. Various amendments were made to the search terms to ensure articles addressed both sexual harassment and the mining industry, as preliminary searches uncovered numerous articles related to 'data mining' that needed to be excluded. Titles and abstracts were searched for key words. Additional data was then sourced by manually reviewing the reference list of chosen articles, and through an additional search of the first 20 pages of results in Google Scholar, consistent with accepted practice (Haddaway et al., 2015).

The literature involving women's participation in mining, mainly focused on Artisanal and small-scale mining (ASM), with some papers focusing on larger-scale industrial mining. Additionally, much of the research focused on countries within the African continent, namely the Democratic Republic of Congo (DRC). Although these findings are contextually specific, there are components that remain significant to mining globally. Of the peer-reviewed research, the country and number of sources include Global (8), DRC (4), Australia (4), Ghana (2), South Africa (2), Uganda (1), Tanzania (1), Mozambique (1) US (1), Papua New Guinea (1), Indonesia (1) and grey literature from Australia (6).

This literature review is informed by a final collection of 34 articles (see Figure 4): including 28 peer-reviewed academic articles and six grey literature documents (i.e., government reports and evidence scans).

The findings suggest that although prevalence rates vary, working culture, including an environment that encourages a masculine culture which permits harassment, contributes to rates of sexual violence and harassment.

Figure 4 PRISMA flow diagram of literature review stages
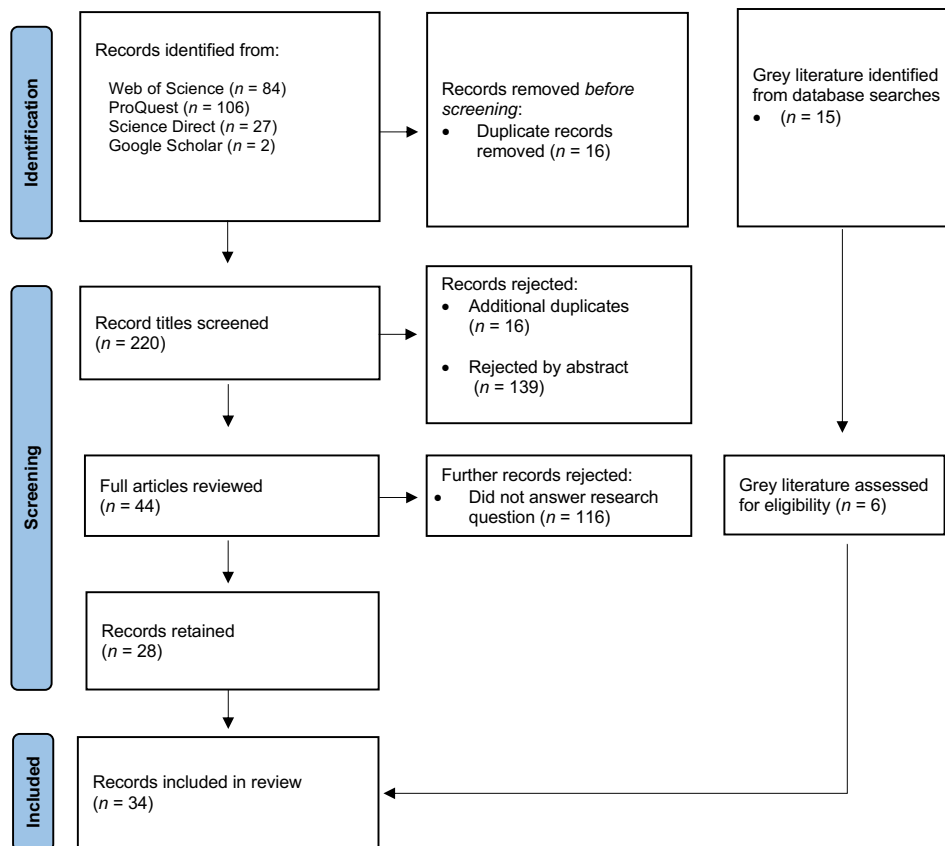
Perceptions, prevalence, and contributing factors (RQ1)

This review sought to understand the prevalence of, and contributing factors to, sexual harassment in the mining industry. Perceptions of sexual harassment were also explored; however, these data were limited. Twenty-two of the included articles informed Research question 1.

Women were found to be particularly susceptible to exploitation such as sexual violence, pay inequality and unequal employment opportunities (Kelly et al., 2014). Much of the research explored sexual harassment and violence within a global context, however much of this was applicable to the Australian mining industry. Overall, sexual harassment was found to have a history of being minimised in the mining industry however (Boyer et al., 2017; Buss, 2018). According to Kansake and colleagues (2021), 'harassment cannot be overstated' as an impact of mining booms across the globe. The findings suggest that although prevalence rates vary, working culture, including an environment that encourages a masculine culture which permits harassment, contributes to rates of sexual violence and harassment.

Prevalence

Specific prevalence rates of sexual harassment and violence varied between studies. While men also experience sexual harassment, women are more likely to be victim-survivors and they face an exacerbated risk. Sexual harassment was found to be prevalent within the mining industry, with some workers facing discrimination or exploitation on a daily basis, varying from the use of vulgar derogatory language to name calling, whistling, to touching, physical contact and sexual assault (Botha, 2016).

In the Australian Human Rights Commission Report *Respect@Work* (Australian Human Rights Commission, 2020) which documents sexual harassment within the workplace in Australia, the mining industry was found to have a 40% prevalence within the workplace compared to the national average where prevalence of sexual harassment across all industries was 31%. Women were found to be more than twice as likely (74%) as men to be sexually harassed (32%) (Australian Human Rights Commission, 2020). According to a recent parliamentary inquiry, 74% of female mining workers had experienced sexual harassment while at work (Australian Human Rights Commission, 2020). Most of the articles reporting prevalence found around half of employed women have experienced sexual harassment at some point in their lives within the mining sector (Botha, 2016; Hill et al., 2021; Perks & Schulz, 2020). Whilst sexual violence against men was also reported, the research in this area is limited and in need of elaboration (Buss, 2018).

A study in rural Australia (108 participants) found 46% of those interviewed believed they worked in a culture which permits sexual harassment (Saunders & Easteal, 2013). Seventy three percent of respondents from the same study reported they had experienced sexual harassment by a colleague, with the most common form of harassment being verbal abuse (73%), obscene gestures (53%), pornography (37%), and physical forms of abuse (29%) (Saunders & Easteal, 2013).

Women who live closer to a mining site were found to be more at risk of sexual violence, highlighting an underlying culture of violence in the broader community. Within Australia, one study reported that females within a mining sector are at a higher risk of assault, specifically a 64% increased risk of assault and a 136% increased risk of sexual assault, compared to females in other areas (Gilmore et al., 2016). These data comprised police-reported assault offences, so are likely to be an underestimate, particularly given widespread reluctance to report these events to authorities (Botha, 2016; Manning, 2016). Gilmore and colleagues (2016) found higher rates of sexual assault and violence were found in regional and rural areas where mining occurs, compared to other metropolitan areas. Assaults among females and males were found to be higher in regions where mining is a significant employer of residents or FIFO and DIDO workers, with the mining boom considered to have made a significant impact in this violence (Gilmore et al., 2016).

A study of abuse data from 15 countries in Sub-Saharan Africa found women from mining areas were slightly more likely to experience domestic violence compared to those from an area where there was no mining. The risk of violence was exacerbated in areas with more general acceptance of such abuse (Kotsadam et al., 2017). This study found that a location close to a mine increased the risk of women becoming victims of sexual harassment and violence compared to locations further away (Kotsadam et al., 2017). Younger women were found to face a higher risk of being affected by sexual violence in mining areas (Kotsadam et al., 2017). A quantitative study of 263 female workers, from Australian and international mine sites of Australian-based mining companies, found older women reported lower levels of harassment and organisational sexism resulting in higher levels of job satisfaction (Rubin et al., 2017). Women of colour were found to be more likely to face sexual harassment

(Botha, 2016).

Differences between countries was also found with women working at Australian mine sites experiencing significantly fewer mental health problems and less interpersonal and organisational sexism than women working at African, South American, and South-East Asian mines (Rubin et al., 2017). Specific prevalence rates varied between studies and locations. A global online survey with an open-ended questionnaire conducted in countries such as Canada, US, Ireland, and the UK collected data from eighty-seven women engaged in the global mining industry. In this study, 53% of women reported gender-based discrimination, 37% had experienced sexual harassment, 17% received sexual demands during the hiring process (Kansake et al., 2021; Lahiri-Dutt, 2022). Only 24% of respondents had reported their discrimination or harassment, indicating that most do not feel safe to report their experiences (Kansake et al., 2021). Another review found that 40% of women in the mining sector in Chile had experienced sexual harassment and 20% had been touched inappropriately, whilst within Canada, one-third of women in mining had experienced workplace harassment or violence within the last five years (Perks & Schulz, 2020).

Experiences of sexual harassment within the mining industry can be ongoing, include more than one person and may include a series of escalating events and incidences (Knapp, 2016). Sexual violence both within mining communities and the regions in which they sit, has been found to an area of growing concern (Kotsadam et al., 2017). Fifty three percent of participants in Saunders and Eastel's (2013) study in Australia noted that the harassment they experienced occurred within pack behaviour with more than one man involved, escalating the experience. Australian research has shown that within the mining industry, the average number of harassers per incident is 3.0, as opposed to the national average of 1.7 harassers per incident (Australian Human Rights Commission, 2020). A study involving focus groups and interviews in DRC found that participants considered rape and sexual assault to be a part of sexual violence as often a pervasive and sometimes subtle act that occurs in mining industries, not simply a violent act without consent (Kelly et al., 2014).

Although prevalence rates varied between and within countries, the majority acknowledged that sexual violence including sexual harassment remains underreported. Younger women, as well as those of demographical intersectionality (e.g., people of colour, those with disabilities and Aboriginal and Torres Strait Islander peoples) were found to be more at risk of sexual harassment.

Contributing factors

Individual influences

Elements of power. Women may experience negative impacts from unequal gender relations such as disrespect, harassment, physical, verbal, and sexual abuse (Botha, 2016; Maqubela et al., 2020). Females disproportionately experience sexual harassment in the workplace, reflecting gender relations and gendered power dynamics, "a focus is [therefore] needed in terms of how power – in all its dimensions – is distributed between men and women" (March 1999, as cited in Hill et al., 2021, p, 231). Women and people who have experienced sexual harassment within the workplace often expressed feelings of powerless and helplessness in their situations (Botha, 2016), thus contributing to a decline in psychological health, confidence, and emotional trauma.

A wage gap still currently exists, globally and within Australia, between women and men. This contributes to the perceived hierarchy within social structures, where women are frequently expected to undertake subordinate roles (Bashwira, 2014). This also contributes to differentiation in power dynamics (Jenkins, 2014). Men may be threatened by women in positions normally occupied by men and may reassert their social position through harassment and sexual violence as a way of enforcing boundaries and exercising power (Kotsadam et al., 2017; Saunders & Easteal, 2013). In addition, there can be a hidden structural element to violence through patriarchy where masculinity may normalise violence, and in particular sexual violence, as a way of expressing power and dominance over others (Manning, 2016).

Survey data from Kansake and colleagues (2021) investigating harassment of women in the mining industry on a global level found most sexual harassment cases are perpetuated by superiors and colleagues of a similar level. Twenty nine percent of participants reported being harassed by their superiors, while 10% were harassed by their colleagues (Kansake & Sakyi-Addo, 2021). Some research indicates that some men may use sexual harassment as a tool to maintain established dominance within the workplace (Botha, 2016).

Job level influences

Working circumstances. Three articles referred to working circumstances. Within Africa, working night shift and feeling unsafe when walking to a vehicle at night were both associated with greater incidences of, or concerns around, sexual harassment and sexual violence (Botha, 2016). A lack of security, and the absence of law enforcement and monitoring bodies also contributed to levels of harassment and sexual violence (Perks & Schulz, 2020).

Other studies have indicated there is an association with risk-taking behaviours and work within the mining industry (Saunders & Easteal, 2013). Shift work has been found to be a key driver of risk-taking behaviour, where non-standard working hours are associated with a lack of community connectedness, poor morale and contribute towards the breakdown of meaningful personal relationships (O'Mullan et al., 2018), which potentially may contribute to a prevalence of sexual harassment within the industry.

Local context (work group) influences

Workplace culture. Workplace culture was found to be the most common contributing factor to sexual harassment and sexual violence in the mining industry (Boyer et al., 2017; Gilmore et al., 2016; Huggins et al., 2017; Kotsadam et al., 2017; Perks & Schulz, 2020; Saunders & Easteal, 2013). A core aspect of workplaces, 'workplace culture' represents "shared perceptions of organisational policies, procedures and practices both formal and informal" (Reichers & Schneider, 1990, p.22). These

shared perceptions provide a frame of reference for appropriate behaviour and have been identified as highly influential (Reichers & Schneider, 1990). Gendered social expectations tend to stigmatise, reproduce gender inequalities in power relations, and segregate individual labour depending on gender and perceived capability to perform roles within mining sites, including leadership roles (Arthur-Holmes & Busia, 2022). Sexual harassment is often normalised as an occurrence within the mining industry (Jenkins, 2014). It is perceived by (mostly) men to be tolerable and acceptable, whereas women tend to see harassment as more severe and inappropriate than their male counterparts (Botha, 2016; Hill et al., 2021; Knapp, 2016). There has been an underlying perceived 'culture of impunity' where in the past, perpetrators do not expect to be reprimanded for their actions (Buss, 2018). In some workplaces, an unwritten code of silence exists to enable them to enact actions of sexual harassment (Lahiri-Dutt, 2022). If workers perceive an organisation to be tolerant of sexual harassment and without consequence, the frequency and severity of sexual harassment was found to increase (Knapp, 2016).

Females are more at risk of being discriminated against due to their gender (Bashwira, 2014). Entrenched patriarchy, social norms, and biases against women, as well as a lack of industry policy and comprehensive frameworks contribute to these gendered impacts. A qualitative study by Bashwira and colleagues (2020) in the eastern DRC identified the most prominent challenge facing women in mining were cultural beliefs which informed tolerance and contributed to the widespread nature of sexual harassment. An Australian study found some behaviours have become so normative in the workplace, that there is no reaction, perceived wrong or consequence (Saunders & Easteal, 2013).

Masculine culture. The mining industry and resource extraction sector feature a prominent 'hyper-masculine' culture (Boyer et al., 2017; Gilmore et al., 2016; Huggins et al., 2017; Kotsadam et al., 2017; Perks & Schulz, 2020; Saunders & Easteal, 2013). The 'masculinisation' of remote areas in Australia has increased both violence and alcohol use among workers within specific mining communities in rural and regional mining regions (Gilmore et al., 2016; Jenkins, 2014).

If workers perceive an organisation to be tolerant of sexual harassment and without consequence, the frequency and severity of sexual harassment was found to increase (Knapp, 2016).

When transgressing traditional gender notions and norms, women are particularly vulnerable to sexual violence and harassment (Jenkins, 2014). Women are often perceived as a threat and as vulnerable workers subject to a perceived level of sexual propriety (Boyer et al., 2017). Jenkins (2014) found that even in higher-income countries such as Australia, with recognised equality legislation, mining is still considered to be 'men's work', creating barriers to women's full participation in industry. The macho culture contributes to the inherently violent impact of the mining industry and women are exposed to complex power dynamic issues (Kelly et al., 2014). Male workers were found to be "not only drilling the rock but drilling a particular kind of masculinity into each other" (Lahiri-Dutt, 2022 p.516). Some workplace cultures may even condone violence against women (Our Watch, 2019). It is also postulated that harassment and violence are used as tools to ensure women remain as 'outsiders' (Saunders & Easteal, 2013, p. 221). Saunders and Easteal (2013) argue that the hostile, sexualised environment created within a male-dominated workplace such as mining, maintains the masculine ethos ingrained within rural life in Australia.

It is suggested that the male ego and perceptions of mining as a 'man's world' contribute to sexual harassment, general sexism, and sexual assaults in the mining industry globally (Kansake et al., 2021). In their qualitative study of mine workers withing the DRC, Kelly, and colleagues (2014) found male participants considered women to be at fault of the sexual violence that occurs. Further, findings suggest that the necessary support for new female colleagues was often lacking, due to male workers refusing to provide (or lacking in quality) the induction processes, camaraderie and cooperation needed to succeed (Botha, 2016).

Manning (2016) contentiously posited that those drawn to capitalist resource extraction industries ascribe to a "Western gendered ideology [that] continues to construe nature as a passive resource to be exploited, controlled, used and abused" (Runyan & Peterson, 2018, p. 219). This ideology is often also translated to women's bodies, justifying and normalising sexual violence (Manning, 2016). Masculine culture determines that physical prowess is an important factor to 'being a man', and performative masculinities may translate as harassment and violence in an attempt to assert superiority and power over women in mining (Maqubela et al., 2020).

Organisational influences
Organisational sexism and masculine culture are prominent within the mining and can contribute to sexual harassment, often compounded with other burdens on women, such as juggling responsibilities, less opportunities and working in an environment with a skewed sex ratio (Rubin et al., 2017). Social dynamics and structures often create webs of power relations that discriminate and oppress; however, they also empower women through opportunity to work within the mining sector that were previously either inaccessible or in some countries prohibited (Sovacool, 2021).

Higher-level external influences
Gender proportions. Sexual harassment was found to be more prevalent within workplaces where the gender ratio tends to be skewed (Knapp, 2016; Maqubela et al., 2020). Women overall, are much less likely to be employed in the extractive and resource industries (Manning, 2016). In male-dominated workplaces, females are more likely to be noticed purely due to singularity and distinctiveness in these environments (Botha, 2016). Women are therefore particularly vulnerable to sexual harassment in male-dominated workplaces such as the mining industry (Botha, 2016). Research from South Africa found that gender disparity within the mining industry is further exacerbated by unhelpful company policies and unsupportive supervisors leading to further segregation and power imbalances (Kansake et al., 2021).

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Strategies and interventions, and effectiveness (RQ2)

A range of interventions to address sexual harassment were described in the literature. Nineteen studies informed this research question. Known interventions include:

- workplace policies to minimise and acknowledge sexual harassment in the workplace;
- improved reporting lines;
- training and education around sexual harassment and minimising sexual violence;
- increasing the visibility of women; and
- ensuring diversity of management.

Strategies which examine changing gendered community dynamics and promote acceptable norms around appropriate sexual behaviour can assist to minimise prevalence of sexual harassment (Jenkins, 2014). Although a range of strategies were identified in the scoping literature review, most studies focused on gender, encouraging more female representation within mining. Jenkins (2014) however, identifies that underlying structural issues need attention rather than simply ensuring more females are employed within the sector.

Many companies do not adhere to best practice principles when it comes to policies and procedures with noticeable outcomes (Knapp, 2016). However, some companies have been identified as making positive changes in their approach to sexual harassment (Sinclair, 2021). The Australian Human Rights Commission has recommended that organisations should adopt a mixture of preventative strategies as best practice, including adopting and encouraging healthy, respectful, and safe work environments, providing training and education on sexual harassment, and developing and implementing comprehensive policies (Australian Human Rights Commission, 2020).

Policies

Although suitable policies are available, there are often issues with implementation and enforcement (Botha, 2016). Policies were found to be an important but often misrepresented intervention within the mining industry. Enforcement of policies with fair penalties and investigations to provide security for those experiencing or at risk of sexual harassment are encouraged and are expected to reinstate confidence and encourage diversity, given previously policies have been unfavourable towards gender discrimination (Kansake et al., 2021). Despite comprehensive workplace policies, implementation and adherence is known to differ depending on workplace leadership, and their support, knowledge and commitment to company policies and values (Knapp, 2016). Leaders must view sexual harassment as a serious offence to reduce the severity and frequency within the workplace (Knapp, 2016). Human resource departments and the individuals who enforce such policies need to be trustworthy, reliable, and accountable due to the high level of trust required, and the need to ensure that people who have experienced sexual violence and harassment within the industry feel safe and secure (Kansake et al., 2021).

Knapp (2016) found that effective policies should be communicated clearly, be widely understood, and upheld. Policies should therefore be disseminated at the time of hire and re-distributed periodically. Policies are not always easily implemented or adhered to, and they must confront the masculine cultures and gendered norms of the past (Sovacool, 2021). Rio Tinto, in conjunction with White Ribbon Canada, implemented one of the most progressive policies to date in terms of preventing harassment in the workplace and tackling gender-based violence. This process included plans to

establish an accreditation system to prevent gender-based violence, highlighting encouraging work in this space (Perks & Schulz, 2020).

Gender is often overlooked in developmental policies (particularly in the ASM industry), where there is an assumption, mining is a male concern. Even at a leadership level, policies are often overlooked due to unsupportive management and problematic company policies (Kansake et al., 2021). Therefore, policies need an integrated pro-equality stance at both formal and informal implementation levels (Yakovleva, 2022). Indeed, both practitioners and policymakers should adopt a more inclusive approach supporting both women and men in challenging patriarchal relations (Sinclair, 2021). Organisations with well implemented, transparent sexual harassment policies were more likely to limit negative behaviours, particularly verbal harassment (Saunders & Easteal, 2013).

Reporting

Previous studies strongly indicate that the least likely response to an incident of sexual harassment is for a victim survivor to make a formal complaint or report the incident (Botha, 2016; Kansake et al., 2021; Knapp, 2016). In addition, most employees are not well informed when it comes to proper reporting channels for sexual harassment and abuse (Botha, 2016). A range of social, economic, and legal obstacles and considerations may also impact reporting, these may include, maintaining both economic and physical security, the fear of facing gender oppression, or the threat of further violence (Buss, 2018).

A global study amongst women in the mining industry found 54% of participants felt their reported cases were not investigated properly or fairly, and 55% indicated they did not feel safe reporting their experiences (Kansake et al., 2021). Many participants from this sample were from Ghana and Africa, therefore the small sample size of eighty-seven and the underrepresentation of higher income countries such as the United States and Australia, may limit these findings. Where rape had occurred, those who had experienced sexual violence tended to not report their case to the police or seek medical care (Steele et al., 2019). This may be also associated with a lack of access to suitable services (Steele et al., 2019), which can be aligned with rural and remote communities in Australia.

Three studies discussed reasons preventing women from reporting sexual harassment and assault. Reasons included:

- a fear of losing their job;
- a lack of knowledge around complaints procedures and policies;
- a lack of knowledge regarding individual rights;
- a resistance to put colleagues in a 'bad position;
- 'unfair' investigations; and
- a fear of retaliation or victimisation (Botha, 2016; Kansake et al., 2021).

A mixed-methods study in central Africa found stigma and threats of further violence from perpetrators may also prevent women and men from coming forward to report sexual harassment (Buss, 2018).

A need for anonymous reporting has been identified and should be explored to protect those who have experienced sexual assault (Botha, 2016). In some cases, tokenistic reporting and investigation teams had been implemented to deter further sexual harassment, however these were found to be dismissive of past cases which had a detrimental impact on workplace culture and confidence (Sinclair, 2021). Systems of reporting that do not adequately respond to sexual harassment and violence not only fail those who need services, but subsequently condone violence, illustrating a need to improve both reporting lines and support services within the industry (Our Watch, 2019).

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Workplace education and training

A need for workshops and ongoing training was identified in several studies (Botha, 2016; Perks & Schulz, 2020; Saunders & Easteal, 2013). Workplace training and education can assist to address sexual harassment by demonstrating an employer's commitment to tackling sexual harassment and initiating change through understanding and combating of workplace expectations, behaviours, and cultures (Australian Human Rights Commission, 2020). While it is important that training programs target those most at risk of offending or engaging in sexual harassment, this approach can be problematic and hence universal training is recommended (Knapp, 2016). Training should be inclusive and culturally sensitive (Legislative Assembly Community Development Justice Standing Committee, 2022). However, training alone is not enough to address sexual harassment and must be supported by other approaches, such as improved policies and supportive services for survivors (Australian Human Rights Commission, 2020).

Training should include information relating to policies and procedures currently implemented within the organisation, explained simply for successful prevention of sexual violence in the mining sector (Botha, 2016; Perks & Schulz, 2020; Saunders & Easteal, 2013). Ongoing awareness, education and training are critical to empower women, to safeguard them from harassment and to ensure rights are respected (Mwakumanya et al., 2016). Bystander intervention training has also been recognised as a useful strategy which empowers those who witness a sexual harassment to intervene (Australian Human Rights Commission, 2020). Bystander interventions encourage individuals who may witness or have knowledge of violence or harassment to intervene where safe to do so, which may reduce harm or even prevent sexual harassment and violence from occurring (Mcdonald et al., 2016).

However conventional approaches to training and education within the workplace have been found to have varying degrees of success. Training based on formal compliance, structured, standalone, or directed to acknowledge sexual harassment (particularly alongside other areas of discrimination such as workplace bullying) has been found to be unsuccessful, particularly if training operates as a tick-box to avoid employer's legal liabilities to ensure compliance (Australian Human Rights Commission, 2020).

Due to budget constraints and convenience, much sexual harassment training has been conducted online. This has led to a lack of engagement and means that content may not be viewed seriously (Australian Human Rights Commission, 2020). The efficacy of workplace training is reliant on the suitability and engagement of the facilitator(s), how the training is delivered and whether the intervention is supported by a broader holistic strategy; meaning the education program is not an isolated standalone component (Australian Human Rights Commission, 2020). A focus on fear-based messages is known to have limited impact (United Nations Women, 2019). Training should be inclusive, readily available and engaging, accommodating the needs of women, men, gender diverse and non-binary workers (Australian Human Rights Commission, 2020).

Visibility of women

While the mining industry, alongside other male-dominated workplaces, have made various commitments to employ a more diverse range of employees, the representation of women in the mining industry remains low. Within the mining sector, women comprise only a small proportion of the workforce. Women's perspectives are therefore ignored, overlooked, or underestimated within extraction industries (Hill et al., 2021), particularly in terms of high-level decision making and solutions to face gender-based violence (Perks & Schulz, 2020).

Visible leadership, with a strong ongoing commitment to uphold policies regarding sexual harassment, was identified as an important contributing factor to mitigate risk.

Mining associations concerned with women's issues or involving women were also recognised as suitable structures for further support through this review, for instance in a study conducted in Mozambique, associations were found to be comprised entirely of men and therefore the needs of other genders remain invisible (Huggins et al., 2017).

Women in mining are often employed in administrative positions, constituting a small percentage of the workforce, for example, in a global survey, 20% of women were employed in mining administrative positions (Kansake et al., 2021). Within Australia, 2011 census data found the industry to be male dominated, with only 17% of the workforce identifying as female, and this included those that work in head offices within the city (Australian Bureau of Statistics, 2013). An increase of women's involvement, particularly in management and executive boards has been suggested to be an effective measure to ensure gender-sensitive policies are considered and upheld (Arthur-Holmes & Busia, 2022; Rubin et al., 2017). However, it is not enough to simply employ greater numbers of women; while employing a greater proportion of women encourages diversity, structural issues need to be addressed to tackle underlying workplace culture and ensure systemic change (Jenkins, 2014).

Role of management
Visible leadership, with a strong ongoing commitment to uphold policies regarding sexual harassment, was identified as an important contributing factor to mitigate risk. Previously, management structures may have been dismissive of claims of sexual harassment and assault, contributing to a rise in sexual harassment prevalence and a workplace culture which permits sexual violence (Sinclair, 2021). Management must be versed in policy and impacts on gender specifically, to understand the ways in which rights can be abused and concerns made invisible (Hill, 2021). Finally, more women in management roles can assist with participation in and resistance towards sexual harassment primary prevention initiatives (Saunders & Easteal, 2013; Sinclair, 2021).

Individual level factors
At an individual level, employees can work towards creating and ensuring a harassment-free workplace, without fear of oppression (Kansake et al., 2021). Individual contributions include reducing sexist comments, ego, prejudices, and unconscious bias, where instead women and people of diverse groups should be made to feel included, supported and welcomed into the industry (Kansake et al.,2021).

International support

Several global conferences have taken place, focusing on gender equality in mining in recent years. In 2018, the World Bank Group hosted the first global gender in extractives conference: *'Gender in Oil, Gas and Mining: New Frontiers of Progress, Challenges and Solutions'*, to tackle issues of gender inequity (Perks & Schulz, 2020). In addition to providing funding to address gender gaps in the mining industry, these conferences allowed for information and knowledge sharing to tackle issues relating to gender inequality including topics that sit in peripheral to this (such as sexual harassment), as well as an opportunity to measure, strategise, and share contributions made on a global scale (Perks Schulz, 2020).

Due to the prolific nature of sexual violence (particularly in Africa), international efforts have focused on offering aid to certain mining regions. Organisations often offer the provision of comprehensive counselling, medical care, and mentorship to sexual assault survivors through primary health care and sexual assault centres (Steele et al., 2019). While these measures have been introduced within areas heavily affected by sexual violence on an international level, similar service provisions are advised where possible. Similarly, international research and attention by outside advocacy organisations have focused on sexual and gender-based violence, where programs by developmental organisations have focused on 'victimisation' (Kelly et al., 2014). Research shows that there should be movement towards empowerment rather than portraying women as victims. International organisations can operate as an ally for women, being a source of support and legal knowledge that may not be available in local mining regions, placing responsibility for citizens on the state as per international law (Manning, 2016).

Contributing to understandings and future implementations (RQ3)

Twenty-three articles helped to inform this research question which focused on how research can inform interventions aimed at preventing sexual harassment in the mining sector. Issues for consideration in future initiatives were identified.

Policymakers, researchers, advocacy groups and governing bodies have identified the mining industry has an underlying culture of sexual violence, where sexual violence and mining are inextricably linked (Arthur-Holmes & Busia, 2022). Evidence-informed research and evaluation activities are required, to develop appropriate strategies to tackle real sexual violence issues, and to ensure their ongoing sustainability and success.

Globally, companies have made minimal commitments to ensuring safe and comfortable workplaces for women in mining; while some policies exist, they are not always enforced (Kansake et al., 2021). There are spaces where other companies are making noticeable changes in terms of addressing gender equality and in turn, sexual harassment in mining. Public awareness around sexual harassment and violence in wake of the #metoo era, including an increase in self-identifying instances of personal sexual harassment and violence, indicates that a shift to concrete changes leading to systemic change is due (Our Watch, 2019). Within Australia, consent is currently featured heavily within the media, where the notions and focus on consent may have permeated wider society, potentially allowing less tolerance for sexual violence and more awareness around perpetrator behaviour.

Two articles recommended that future policymakers, researchers, and organisations move beyond viewing women as a homogenous group of people and consider their specific needs, backgrounds, and interests (Bashwira, 2014; Bashwira & van der Haar, 2020). Specific attention should be given to those who identify as LGBTQI+[6], first nations populations and those with disabilities, to develop a 'real picture of diversity, opportunism and agency' (Bashwira, 2014; Bashwira & van der Haar, 2020)

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6   The acronym LGBTQI+ represents lesbian, gay, bisexual, transgender, queer, intersex and other identities.

Clearer definitions around sexual harassment and sexual violence are also needed, including an examination of any overlap in terminology, to help streamline future research efforts. The term sexual harassment can be used to diminish the severity of sexual violence and in some workplaces, there tends to be a simplification of what sexual violence entails (Buss, 2018).

Evaluation

This scoping review found few examples of evaluation activities seeking to measure the efficacy and/or effectiveness of interventions focusing on the prevention of sexual harassment and/or sexual violence. Evaluation should be ongoing and include regular monitoring and adjustments (Gilmore et al., 2016). It is imperative to ensure interventions are achieving the desired outcomes and do not have iatrogenic effects (Hill et al., 2021). Very little evidence exists on the effectiveness on current and pre-existing measures. The Australian Human Rights Commission (2020) encourages feedback and evaluation pertaining to sexual harassment training; however, no studies currently exist which examine effectiveness in terms of interventions used to tackle sexual harassment specifically within the mining industry. Future research using quasi-experimental design, qualitative research or randomised control trials could be useful to measure effectiveness of training and other interventions used thus far.

Further considerations for interventions and research

Throughout this literature review, themes of power and the impact it has on sexual harassment were evident. Sexual harassment specifically, can be perceived as an abuse of power, where those in positions of authority or power often use their position to exploit subordinates (Wharton, 2006, as cited in Botha, 2016). The dynamics of power imbalances therefore should be considered when implementing future strategies and implementations.

Reliable, current, and longitudinal data is needed to identify the barriers and enablers for female miners to achieve greater respect, recognition, and representation within the industry. This will assist employers and stakeholders to allocate resources and funding more appropriately and understand areas that require improvement (Kansake et al., 2021). A focus on changed gender dynamics and intersectionality in terms of gender should be considered and explored (Lahiri-Dutt, 2022; Manning, 2016). Intersectionality refers to the complex dynamics and structures of power which create overlapping forms of marginalisation and discrimination, for example, women of colour, older people with disabilities (Manning, 2016). Applying an intersectionality lens to gender can add nuance to our understanding of experience and perception by considering multiple categories at once (Rosette at al., 2018). For example, a Western Australian study found fifty five percent of Aboriginal and Torres Strait Islander women had experienced sexual harassment in the workplace, compared to 39% of all women (Australian Human Rights Commission, 2018). However, there is limited evidence of specific research around First Nations peoples employed in the mining sector in Australia or internationally.

Binarised gender continues to prevail in the mining industry (Boyer et al., 2017). Fifty two percent of diverse sexual identities had experienced sexual harassment in the workplace compared to 31% of heterosexual people, demonstrating further marginalisation and discrimination for minority groups (Australian Human Rights Commission, 2018). There are a lack of studies focusing on the impact of sexual harassment and violence in the mining industry on sexual and gender diverse people (Hill et al., 2021). No studies were found which examined people who may have experienced disproportionate levels of sexual harassment due to additional levels of intersectionality, including religion, culture, or disability. Often violence, particularly sexual violence treats minorities as separate, however intersectional feminist theory

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posits that there are overlaps and similarities, therefore, a holistic approach which ensures inclusivity is better suited for intervention strategies (Our Watch, 2019).

Indeed, research indicates that gender inequality is not experienced in the same way by everyone (Our Watch, 2019). Mining policy commitments to gender diversity ensures women are represented in suitable associations and frameworks, however the research in terms of women, their experience and impacts within the mining industry is however, limited (Jenkins, 2014).

According to Sinclair (2021) the impacts of mining are gendered, that is, negative impacts are disproportionately accrued to women, and opportunities to men. However, a focus on women's agency in employment, participation, and resistance, creates a climate where women become less reliant on interventions for empowerment or equality. It is imperative women are not perceived or represented as victims (Sinclair, 2021). It is critical that future programs empower women, and others at greater risk of sexual violence, to participate in decision-making processes, strategy planning and ongoing research or evaluation activities (Hill et al., 2021). Finally, when addressing gender imbalances and social structures within the mining industry, it is imperative that the design and management of these workspaces acknowledges pre-existing authorities and gender relations, to prevent further expansion of power relation issues and inequities (Huggins et al., 2017; Lahiri-Dutt, 2022).

There is a lack of research highlighting miner's perspectives on solutions to address sexual harassment and workplace culture within Australia and indeed, globally. A study by Rubin and colleagues (2017) found that a progressive approach regarding equality such as instigating flexible work arrangements, enacting workplace diversity forums where women and minorities can freely voice their concerns, and intermittent diversity surveys to check and maintain progress, worked well to ensure women felt heard, acknowledged, and supported. Adequate maternity leave, flexible working rotations which accommodate both family and career commitments, an environment which prohibits sexual harassment and treatment of women as equal (both on an organisational and financial level) can reduce discrimination (Kansake et al., 2021; Perks & Schulz, 2020). These measures may influence pre-existing challenges in terms of job opportunities, increased harassment, and wage gap, which can restrict women's autonomy within an organisation (Sinclair, 2021).

Gender equality has been a key consideration of the UN sustainability agenda, ensuring full and effective participation and equal opportunities for leadership at all decision-making levels (Yakovleva, 2022). 'Gender Mainstreaming' is often cited a primary tool for mitigating negative impacts on women reflected by mainstream literature and Non-Government Organisations (NGOs) (Sinclair, 2021). These efforts, often include both women who work in mines, with women in affected mining communities, noting that mining booms often alter social structures permanently (Sinclair, 2021). When it comes to sexual harassment and violence, the distinctions between these two contexts should be made.

In addition to preventative strategies, interventions should also include access to services to support those who experience sexual violence. Specific services offering psychosocial counselling and support is required, and access to these services has been found to be limited in mining towns (Kelly et al., 2014). Security and safety measures such as the implementation of locks, CCTV, extra lighting, and consideration of the layout of public areas is also recommended to be considered to reduce sexual harassment in mining (Legislative Assembly Community Development Justice Standing Committee, 2022).

In terms of reporting, annual reports that document rates of internal discrimination and harassment, as well as company performance with harassment policy compliance, should be made available to government and mining regulatory bodies, allowing full transparency and accountability (Kansake et al., 2021). Companies should ensure clear career paths for all employees irrespective of gender. Furthermore, annual discrimination and harassment conferences may assist where organisations can present their best practices, results, and interventions to share knowledge with industry to continuously learn and strive for better, improved systems (Kansake et al., 2021).

Workplace training

Organisations need to target training to include diverse groups, raising awareness around increased sexual harassment rates, and the effectiveness of responses to 'assist' such as bystander intervention, and confronting perpetrators (Knapp, 2016). Existing training such as Corporate Social Responsibility (CSR) programs which predominantly focus on men, ultimately contribute to gendered impacts in mining (Sinclair, 2021). CSR examines company activities which measure sustainability performance in terms of social, economic, and environmental factors. (Mancini & Sala, 2018).

Tackling the problem of workplace culture

Strong predictors to sexual harassment in the workplace include high male-to female ratios with masculine cultures (Botha, 2016). Both cultural norms and organisational structures tend to identify male bodies as ideal workers for the mining industry, contributing to further gender segregation where work is often distributed depending on gender, where women are seldom recognised as 'miners' (Arthur-Holmes & Busia, 2022). Some research indicates that some men may use sexual harassment as a tool to maintain dominance within the workplace (Botha, 2016). While no articles in this review specifically referred to ensuring communication and training were targeted for a specific mining population with most males, there is extensive evidence from other industries which suggest initiatives with appropriate message framing, tailored to a specific population or demographic, can be more effective (Australian Human Rights Commission, 2020). The extractive industries, including the ASM sector, have historically been viewed as predominantly male occupations (Arthur-Holmes & Busia, 2022). Stereotypical ideas about mining as 'men's work' need to be challenged to alter and change workplace cultures present within the industry (Jenkins, 2014). There are several structural issues underlying workplace culture that should be recognised and addressed to ensure safe spaces, gender equality and harassment-free workplaces (Lahiri-Dutt, 2022).

Despite gender equality programmes, policies and practices, the mining workforce continues to be dominated by a masculine culture where women may be excluded due to socialised gender norms (Lahiri-Dutt, 2022). Unconventional and comprehensive training was found to be effective to address a workplace culture that was accepting of sexual harassment (Knapp, 2016). Corporate participation to overcome power structures and work dynamics can assist to reduce harms and contributing factors towards sexual harassment (Sinclair, 2021).

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Summary

Limitations and gaps

Significant gaps exist in the peer-reviewed research in relation to sexual harassment in the mining industry within Australia. This literature review found no studies focusing specifically on sexual harassment and sexual violence among sexual and gender diverse people working in the mining industry. The need for research acknowledging violence and harassment against men and LGBTQI+ populations is noted (Buss, 2018). Strengthening gender analysis in terms of impact assessment is also required (Hill et al., 2021).

There is little evidence that programs implemented to address sexual harassment and sexual violence in the mining industry have been evaluated for efficacy and/ or effectiveness. The Australian Human Rights Commission (2020) recognises that research on the efficacy of workplace sexual harassment training is limited and is problematic at both a domestic and global level. Further research is required to evaluate current interventions. This review also highlights a lack of research to understand the mining industry's impact, inclusive of the impact caused by sexual harassment on nearby remote towns and rural communities.

Scoping literature reviews rely on information reported in the included studies. A greater number of studies and a larger dataset may have been possible if authors had been directly approached to help address any identified gaps. Whilst scoping literature reviews have more flexibility than a systematic literature review (Arksey & O'Malley, 2005), there is the possibility that our search strategy did not fully capture all data capable of addressing the research questions.

Future implications

Increased violence against women, including sexual violence and harassment has increased alongside the boom of large-scale mining industries (Jenkins, 2014). Given the masculine culture that underpins sexual violence in the mining industry and associated communities (Gilmore et al., 2016), strategies aimed at changing the workplace culture are best considered. The hypermasculine culture of the mining industry represents a unique and challenging demographic in terms of ascertaining appropriate preventative and ongoing measures to mitigate sexual harassment within the industry.

Further intervention strategies are required to address pervasive workplace culture; however, these should be co-designed and co-implemented with members of the mining community. Involvement of all genders and groups within the mining industry is recommended, to ensure that solutions are endorsed at all levels and are supported by the end users. Women's voices, alongside minority voices that Aboriginal and Torres Strait Islanders and LGBTQI+ populations should be acknowledged and respected. By viewing impacts through a lens of intersectionality, more understanding can be applied to sexual violence and harassment in the workplace and the varying experiences of said violence (Manning, 2016). This could also include perspectives from perpetrators.

Many strategies and interventions found addressed supporting people who had experienced sexual harassment (e.g., improved reporting and support services), however a primary prevention approach as outlined by Our Watch (2019) would be best suited to preventing and reducing sexual harassment and violence in the mining industry long-term and should be supported by institutional and organisational level strategies. A primary prevention approach involves a holistic approach to challenging gender stereotypes, as well as the condoning of violence against women and minority groups, together with supporting and strengthening positive and respectful

relationships between co-workers of all levels, genders, and sexual identities (Our Watch, 2019).

The development and implementation of strong workplace policy is imperative. The lack of reporting appears to be a due to a perception of workplace complacency and inaction, or fear (Knapp, 2016). Workers need to feel confident that policies are clear and will be enforced. This will deter perpetrators from enacting sexual harassment and empower victim survivors to report their experiences (Kansake et al., 2021). Greater transparency, in the form of increased public-facing documentation is required to reinstate confidence among victim survivors and potential victims of harassment (Knapp, 2016).

The Australian Human Rights Commission's *Respect@Work* Report (2020) acknowledges that although workplace training and education can be a valuable tool to address sexual harassment, current iterations are lacking and are responded to with disdain when acknowledged directly as sexual harassment training programmes. In addition, there are structural gendered impacts evident in the mining industry such as power dynamics, a lack of regard for others including women, and perpetuated gender stereotypes that need to be addressed. This issue contributes to a workplace culture which permits sexual harassment. Current interventions should be evaluated, their effectiveness and efficacy measured, and the findings used to inform potential changes and new programs. Modern programs and associations with inclusivity in mind, are encouraged. Organisations such as 'Me too Mining Association' work to empower all workers and offer inclusive workplace training programs such as the Digger Program to Canadian mining industries (Me Too Mining, 2022).

Initiatives should be engaging, invigorating, or inspiring activities to reinvigorate workers and maintain their interest. Training which addresses contributing factors to sexual harassment without identifying sexual harassment specifically could be more effective than current interventions. Workplace training that engages with empathy training, educating about power imbalances and gender stereotypes, handling rejection and respect specific to an older male-dominated environment in an engaging, unconventional manner could potentially be responded to with less disdain and more engagement, if facilitated and designed well. Our Watch (2019) interventions include appropriating school-based programmes such as Respectful Relationships for workplaces to ensure violence-free spaces and address drivers of sexual violence. Ideally, a programme specifically addressing and suited to the challenges and unique landscape of the mining demographic would be implemented. Further research prior to intervention of this strategy is advised however, to ensure feedback and solutions shared with and from the mining community are considered. Engaging both women and men is imperative to working towards solutions to fight sexual harassment. As women's voices and representation increase, men may feel threatened, inundated and their positions scrutinised, therefore engaging men is critical to preventing sexual violence (Perks & Schulz, 2020).

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Conclusion

This scoping review aimed to investigate the level of prevalence, contributing factors and perceptions of sexual harassment within the mining industry, as well as explore the existing literature around interventions to combat sexual harassment, their effectiveness and future understandings derived from the research. This report ascertained that workplace culture including an environment which permits hypermasculinity and the normalisation of sexual harassment; complexities of power dynamics; and inadequate training and policy, contribute to increasing rates of sexual harassment and violence within the mining industry, globally and within Australia. Although a high prevalence of sexual harassment against women was found within this scoping literature review, limited studies investigated violence against men, areas of intersectionality such as LGBTQI+ and the impact on gender diverse populations, or on Aboriginal and Torres Strait Islanders and those with disabilities (Hill et al., 2019). Further, many of the studies reported small sample sizes. While some studies explored contributing factors, this research was also limited. Greater understanding of sexual harassment and sexual violence in the Australian context is required.

Research determining the effectiveness and/or efficacy of interventions focusing on preventing sexual harassment in the workplace were limited, indicating that further studies measuring the effectiveness and efficacy of specific strategies and programs are needed. An integrated holistic multi-level approach to reduce sexual harassment within the mining industry is recommended. Inclusive workplace and updated sexual harassment policies upheld by trained leadership and suitable, trustworthy reporting lines was found to be a useful approach. Workplace training was found to be one of the most effective measures to reduce levels of sexual assault, however, was found not to be successful in isolation, needing to be supplemented by other holistic workplace measures. Training must be well facilitated, engaging, catering to diverse populations and communicated successfully within a hypermasculine environment. Training should not be overtly linked to sexual harassment and workplace bullying, as these measures were found to be unsuccessful. Despite recommendations around strategies and interventions evidence being limited, this highlights the need for rigorous evaluations in the future. This should include opportunities for co-design with a diverse range of members of the mining industry. Ongoing formative, process, impact, and outcome evaluation should be employed to inform and revise strategies and interventions.

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Chapter 3:
Future of work in the mining industry: Literature review

Yam, C., Anderson, M., Fruhen, L., & Parker, S.

Future of work in the mining industry: Literature review

Context and background

Work continuously changes, often on the back of technological advances, and sometimes with enhanced acceleration. When such acceleration occurs, we call it an industrial revolution. To date, the world of work has undergone three major industrial revolutions – first in the late 1700s with the emergence of steam engines and mechanical production, second in the late 1800s with the advent of electric power and division of labour to drive mass production, and third in the late 1900s with the rise of electronic and information technology to automate production (Schwab, 2015). Some scholars argue that the world of work is on the brink of the next industrial revolution, with emerging technologies being highly autonomous and intelligent (Schwab, 2017) – so too is the mining industry.

CSIRO (2022) predicted that work in the next 20 years will be shaped by a number of global megatrends, such as adaptation to climate change, an increased focus on clean and green energy, as well as an increase in digitisation and autonomous systems driven by artificial intelligence. These changes are already playing out in the Australian mining industry where there has been a shift from mining coal to support global demand for traditional energy sources to mining critical minerals to support global demand for clean energy sources and storage. Further, digitisation and autonomous systems are increasingly implemented across the Western Australian mining industry, such as in automated systems (e.g., BHP's automated shiploaders in Port Hedland, BHP, 2022; Fortescue's autonomous light vehicle project at Chichester Hub, Fortescue, 2021; Rio Tinto's automated heavy haul long distance rail network, AutoHaulTM, Rio Tinto, 2019a, etc.) and remote operating centres. However, it is important to recognise that human workers will be critical to the new work that is developing – and that their roles are likely to change on the back of technological advances. It is critical to ensure that workers are supported during a period of transition and in this future of work. Indeed, major players in the mining industry agree that while technological advances are occurring at an unprecedented pace, people are at the heart of such operations, and supporting workers through these changes will be vital for an organisation to retain its competitive edge in the future of mining (e.g., Rio Tinto, 2019b).

The goal of this literature review is to synthesise the possible directions of the future of mining, identify the potential challenges and opportunities that may accompany advancements in the mines of the future, as well as potential ways to support the workforce in succeeding in the future mines. Figure 5 summarises the current state of work in mining and the hypothesised future of work in mining.

Figure 5 Summary of the current vs future of work in mining

Major Mineral Resources
Iron ore (41.1%); Black coal (27.4%); Gold (10.0%); Bauxite-alumina-aluminium (6.0%); Copper (4.3%)
Figures presented are percentages of Australia's total mineral export earnings (Geoscience Australia, n.d.)

Critical Mineral Resources
Antimony, cobalt, lithium, manganese ore, niobium, tungsten, vanadium (Department of Industry, Science and Resources, n.d.)

Work Tasks
Physically demanding work in mine sites (e.g., drivers, operators)
Physical presence required on site to complete tasks

Work Tasks
Knowledge based
Majority of workforce may be located away from the physical mine site

Workforce
Predominantly male (80.2%)
Average age 41 years old
Technical skills required to operate machinery
(ABS, 2016)

Workforce
More even gender split
Greater proportion of mature workers
Reskilling and upskilling to equip workforce with technological literacy and non-technical skills

Current state of work in mining

Future of work in mining

The future of work in mining

While the specific details of how the next industrial revolution will unfold is at this stage uncertain, it is widely thought that this unprecedented change will be driven by technology such as automation, algorithmic management, and the digital age, and as an extension, the integration of data and artificial intelligence, enabling technologies to become capable of self-directed learning and engage in complex cognitive tasks (Frey & Osborne, 2017) such as analytical and rational processing (Ferràs-Hernández, 2018). The future will be characterised by cyber-physical systems, or systems which integrate technology and human interfaces (Schwab, 2015, 2017). This integration of human and technology will significantly impact the overall structure of the workforce (Brynjolfsson et al., 2018; Huang & Rust, 2018), such that humans are likely to work more closely with technological systems than before, as opposed to being replaced by machines (Parker & Grote, 2020). Predictions around the future mine involve fundamental changes to the way work is completed, such as autonomous operations (train operations, truck haulage, drilling) and the associated remote management of these operations, algorithmic management and predictive analyses, as well as changes associated with the challenges of mining new critical materials. We explore each of these in turn.

Autonomous vehicles, algorithmic management and remote operations

It is widely accepted that automation is here to stay (Schwab, 2015, 2017). Many critics of technology-led workplace changes, especially in automation, argue that autonomous technology (and by extension, robots), will replace the workforce. There is uncertainty within the workforce around how the advancement in technology is likely to affect their jobs. For example, a survey found that 28% of respondents felt 'totally unprepared' for technology changes in the workforce (Thomson, 2018). In the same vein, significantly more people were found to be worried about the impact of automation in the workplace than they were optimistic (Boyd & Huettinger, 2019), and in some cases, the fear of automation was so intense that it caused employees enough anxiety to feel physically ill (Dorney, 2019).

To understand exactly how automation may impact work, Brynjolfsson et al. (2018) analysed jobs in O*NET, an online database and catalogue of occupations, jobs and tasks. They found that while most occupations include some tasks that can be

automated, very few whole jobs can be fully replaced by autonomous operations. As such this finding suggests that the workers of the future are more likely to work alongside machines than to be replaced by them. This finding is in line with other studies which also found that the number of jobs which can be fully automated is very low (e.g., Acemoglu & Autor, 2011; Frey & Osborne, 2017; Muro et al., 2019). In other words, tasks that can be automated exist within a broader role, alongside other tasks that at the present moment, cannot be automated (Parker & Grote, 2020).

How human and machine tasks are designed and integrated can be critical for the design of future work. And we already know about some of the ways in which such integration can affect human performance, safety, and well-being. Today, such systems, including that of autonomous vehicles, still require some level of human monitoring and intervention if and when technology fails. Further, the introduction of automated or remotely controlled systems leads to an irony in that there may indeed be a reduction in actual manual operational activities, but the increase in technological infrastructure leads to an increased requirement related to maintenance activities, such as technological literacy and associated skills. A large body of research (mostly conducted in aviation and defence sectors) have demonstrated that reducing jobs to monitoring autonomous vehicles and systems can further lead to unintended outcomes. Humans are not well-suited to monitoring for extended periods of time – the increased vigilance demands placed on the worker can create problems for motivation, performance, and safety (Parker & Grote, 2020). The presence of human operators monitoring autonomous systems also adds to this complexity by holding a human accountable if things go wrong in a system that they may not understand or have influence over. These issues raise so far unresolved legal, as well as moral issues.

In addition, extensive monitoring can also lead to the loss of situation awareness, or the worker second guessing any recommendations by the system (Grounds & Ensing, 2000). Loss of situational awareness can also be referred to as "out of the loop" problems (Billings, 1991). In one study, operators of automated systems, compared to operators of manual systems, were found to be less likely to detect system errors and intervene appropriately in the face of technological failures, due to the loss off manual skills and situational awareness (Billings, 1991). This may make it exceptionally difficult for workers to take control back from the system when failure arises (Stanton, 2019), or even lead to "automation surprises" where actions taken to remedy the failure may not be the most appropriate due to having lost awareness of the situation (Sarter et al., 1997). An increasing amount of scholars have investigated how humans interact with systems when they do not understand the algorithms and analyses guiding the systems, and the effects of distrust in such systems. An example from the aviation industry relates to the introduction of 'autopilot' mode to increase flight safety. However, the dependence on a system that pilots did not fully understand arguably caused pilots to lose awareness of the situation, resulting in accidents (see for example the accident of flight AF447; Conversy et al., 2014). For example, Grounds and Ensing (2000) found that distrust in algorithmic systems can lead to a 30% increase in decision time – which can have dire consequences in time critical operations. Further, an experimental study demonstrated that a system with no human intervention was safer than systems that allowed opportunities for humans to intervene (Itoh & Inagaki, 2019), suggesting that human intervention, especially in systems which they do not understand, can lead to poorer outcomes. Machine-human systems therefore need to be designed and implemented carefully, in a way that supports, rather than hinders, safe and healthy work in the future mine.

Finally, central operating centres are likely to become more common in the future. It is important to note that they are not a new concept, they are commonplace in other

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industries such as petroleum, defence and aerospace (Farrelly & Records, 2007). However, the technological advances in recent years such as cloud-based tools have renewed interest in advancing remote operating centres, particularly in the mining industry (Gallardo et al., 2020). In part catalysed by the COVID-19 pandemic, some organisations have relocated approximately 15-20% of their on-site workforce – particularly non-frontline roles – to control centres (Gallardo et al., 2020). Such centres capitalise on technology to remove workers from physically dangerous working environments, thereby increasing safety, reliability and productivity of operations from a central location. Following the successful implementation of these remote operations and buffeted by continuous technological advances, it is likely that the mining industry will continue to move towards more remote operating centres (Corrêa, 2021; Gallardo et al., 2020). However, this increased centralised operation inevitably brings about change in the way work is fundamentally carried out and how employees interact with one another (MST, 2021). For example, operators may experience a change in the nature of their jobs – from working in a blue-collar context environment to a more office-based, white-collar environment (Abrahamsson & Johansson, 2021). Workers may also lose some of their implicit understanding of the surroundings in which their work is carried out, if they operate from a distance and in some instances would not be familiar with the "real-world" attributes of their work. For example, thinking about a certain amount of cargo, or a particular machinery in an abstract manner, and without an awareness of its implications can be challenging and may lead to workers underestimating some of the risks that they are managing (Flin & Fruhen, 2015). In addition to the implications for teamwork, other aspects of work and workers may inevitably change, such as the demographic of workers as well as the skills required to perform effectively, as we will discuss later.

Mining critical minerals

Critical minerals refer to materials that are essential for progressing modern technology such as geo-optic cables, clean energy and semi-conductors. PwC (2021) predicted that the global shift to a low-carbon or zero-carbon world will bring with it a projected demand that outpaces near- and medium-term supply. Lithium, cobalt, germanium, and other rare earth elementals, essential in low-emission technologies (Geoscience Australia, n.d.), are just some minerals that have been identified by the Australian Government as having a high geological potential, that is, there is great potential for Australia to supply these minerals on a global scale (Australian Trade and Investment Commission, 2021; Skirrow et al., 2013). In order for Australia to meet the global demand, the Australian mining industry must invest more efforts into exploring, extracting and processing critical minerals (PwC, 2021).

However, there are a number of risks associated with Australia's increased production of critical minerals. The shift in the mining industry from extracting more traditional resources to critical minerals brings with it much uncertainty around how work is completed. While the specific predictions associated with each particular critical mineral is beyond the scope of this review (for more information, see Critical Technologies Policy Coordination Office, n.d.; Geoscience Australia, n.d.), the underlying challenge across all future critical mineral mining efforts is characterised by uncertainty and organisational change that may lie outside of the organisation's direct control (e.g., constraints based on current and changing technologies). For example, the Critical Technologies Policy Coordination Office (n.d.) identified some risks associated with the projected growth in critical minerals, such as the currently insufficient knowledge of critical minerals and their behaviour during metallurgical processing, as well as the need for new mining technology and services to economically extract critical minerals on a large scale. Further, while this is a growing area of interest, there is as yet a relatively limited number of studies

dedicated to mining critical minerals, leading to a lack of knowledge required to foresee unintended risks that may be introduced. These risks point to a general environment of uncertainty in the working environment. When individuals work in such uncertain environments, and when change is outside of the control at the individual or organisational level, this uncertainty can lead to increased stress and mental strain on employees, which in turn leads to dissatisfaction, disengagement, reduced organisational commitment and performance.

From the regulator's perspective, the potential rapid growth of the critical minerals suggests that the capabilities and capacity of the regulator also needs to keep pace with understanding technological advances and the risks associated with implementing new technology. Lessons can be learned from other industries that have undergone rapid technological advancements (e.g., National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, 2011). As we discuss the upskilling and reskilling of workers in the future mine site, so too do regulatory bodies need to be upskilled and reskilled to not only keep current with advancements, but to also be able to synthesise available information to make informed decisions about safety requirements and regulations.

Drivers that may shape the future of work in mining

The mining industry has traditionally been thought of as characterised by physically demanding and dangerous working environments (Abrahamsson & Johansson, 2021). However, the mining industry in recent decades has implemented many initiatives aimed at improving physical safety of miners, such as autonomous vehicles, remote operations and algorithmic management. According to the Australasian Institute of Mining and Metallurgy (AusIMM; n.d.), the future mines will increasingly improve physical safety through changes such as remote operations and improved communication. Advancements in technology can replace "dull, dirty and dangerous work" (Walsh & Strano, 2018), thereby improving physical safety in dangerous environments such as the mine site.

However, future work does not develop in a vacuum and there are a range of factors that may shape how work in the mining industry will look in the future. Future technologies and the new ways of working they enable may however bring new risks and challenges for workers in the mining industry. For example, it is likely that individualised tasks, rather than whole jobs, will be automated (Parker & Grote, 2020). Proactive efforts to design good work that integrates human-centred technologies are likely to generate performance and well-being benefits, while techno-centric changes which do not consider other factors are more likely to fail (Parker & Grote, 2020). It is therefore important to consider how the design of work might change in tandem with technological advancement, as well as how work design and other factors might play a key role in the future mines. Specifically, such aspects can be located at the job (e.g., work design) level, local work group context, or organisational level influences. We discuss the impacts of each aspect in turn.

Work design
Changes in the future of work can be planned and developed so that they strategically support the design of future work aligned with good work design principles. Work design refers to the "content and organising of tasks, activities, relationships, and responsibilities within a job or role" (Parker, 2014). The characteristics of work design generally fall under five main categories. First, work should be stimulating – work that captures the degree of skill use, variety in tasks, and interest in the job itself. Second, work should provide one with a sense of mastery – that is, knowing how to achieve the goal, receiving feedback on performance for

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continuous improvement that support skill maintenance and job performance. Third, individuals should have a degree of agency – control or discretion over when, and how a job is done, as well as discretion over work decisions that impact them. Fourth, the relational aspects of the work should be considered, such as social support from colleagues and supervisors. Lastly, job demands – the aspects of the job that require sustained physical or psychological effort – need to be considered (Parker & Knight, under review). These characteristics of work design are widely thought of to lead to desirable outcomes such as well-being and performance through increased motivation (Hackman & Oldham, 1976) as well as helping employees to meet the demands of their job (Demerouti et al., 2001).

In relation to the stimulating aspects of work design, the future of work in mining may require workers to take the perspective of continuous learning and upskilling. Workers will be faced with increasing changes at work (e.g., automation, new and different minerals, etc.), and need to ensure that their skills remain current and relevant (Caminiti, 2018; Donaldson, 2019). When mundane tasks are automated, this frees workers up to complete more complex tasks which tap on their knowledge and experience. However, technology must be implemented with care such that workers are not relegated to unstimulating work (e.g., extensive monitoring), or that workers distrust the system to the extent that they become less efficient or make more errors.

Technology can enable the efficient and effective delivery of feedback on the job, thereby increasing learning and fostering a sense of mastery. Big data and its associated dissemination allows for organisations to quickly disseminate information to workers, providing them with real-time feedback (Parker & Grote, 2020). However, there is also a potential for technological advancement to reduce feedback, thereby decrease a worker's learning and eroding their sense of mastery. In the long term, this can lead to skill loss (Parker & Grote, 2020). Coupled with the possibility that workers will be required to operate within new environments and systems (e.g., critical minerals), clarity and feedback to support learning will be critical for desirable outcomes. Technology should thus be used to augment, rather than replace, human capabilities in the future mine.

The advances in technology, specifically algorithmic management, suggest that decision making can be decentralised, leading to greater agency at work, in part because the wider distribution of information by the organisation offers the potential for individuals and teams to engage in more localised decision making (Grote & Baitsch, 1991). In addition, the future mine may contribute to greater job autonomy, specifically over where and when to work by enabling connection across geographic and temporal regions (Parker & Grote, 2020). This will enable people to have more control over where and when people want to work, resulting in more flexible working. On the other hand, new technologies at work can also undermine autonomy. The irony of automation is that by automating the "easy" parts of the job, automation can actually make the difficult parts of the job even more difficult by keeping workers out of the loop and not understanding how decisions are made on their behalf (Billings, 1991). However, as previously discussed, the future mine is characterised by uncertainty and new challenges. Wall et al. (2002) argued that in uncertain work environments, increasing agency is appropriate because it provides an opportunity for employees to learn about the environment, tasks and requirements, which in turn leads to improved performance (Leach et al., 2013).

The effects of technology and the future mine on the *relational* aspects of work are varied. On one hand, advances in technology can help workers to communicate more effectively with team members and supervisors. In an industry where a large proportion of the workforce are away from family, friends and other community

supports for long periods of time, increase in technology can also help FIFO and DIDO workers to stay connected to their social support networks. Indeed, studies have documented how technology can help to buffer against loneliness in remote workers (Hislop et al., 2015) and facilitate the development of a shared understanding amongst co-workers (Neeley & Leonardi, 2018). On the other hand, technological advances are also likely to affect social connection and co-ordination practices with the increased availability and use of large amounts of abstract data, thereby increasing the cognitive load on communications, thereby creating significant challenges to communication and co-ordination (Beane & Orlikowski, 2015).

As with the other work characteristics that have been discussed, technology can both increase and decrease the different amount of demands placed upon workers. First, technology can remove workers from dangerous environments and reduce the physical demands, especially on workers whose jobs are characterised by manual labour. However, more computer-related work may mean that instead of staying physically active on the job, workers are now sitting in front of a computer, which can lead to an increase in musculoskeletal and cardiovascular disorders (Parker & Grote, 2020). This change may also lead to increased cognitive demands such as vigilance and attentional demands, which as previously discussed, can lead to increased stress and distrust, and decreased engagement.

Altogether, studies suggest that there is a mixed effect of technology on work design in the future mines. If implemented in a techno-centric, rather than human-centric fashion, technology can quickly result in poorly designed work, which in turn can have dire consequences for employee well-being, performance, engagement, commitment and turnover.

Local context (work group) influences

The local context, site, or work group level can also have implications on the future of mining. Mining is a male-dominated industry, and in Western Australia, the majority (80%) of the workforce in the resources sector is male (Chamber of Minerals and Energy of Western Australia, 2019). This gendered nature of the mining industry suggests that it is important to consider such effects and attitudes in the broader context of the future of mining. Perceptions of masculinity, or the masculine site culture, entails perceptions of social rules or expectations surrounding gendered actions and attitudes (Mahalik et al., 2003), and have been proposed in relation to workplace safety (Reason, 1997).

As discussed above, the characteristics of the future mine are underscored by technological advancements. Abrahamsson and Johansson (2021) suggested that technology may lead to a change in working environment from mechanical underground work to remote operations, effectively turning mining into an office job. One conclusion that they drew was that there are new ways of conducting and defining "mining work", through the changing nature of qualifications, competencies, and identities in mining. The hyper-masculine culture of the male-dominated mine sites are predicted to progressively become more tempered, with indications that traditional gendered stereotypes will be undone in the future mine sites (Abrahamsson & Johansson, 2021).

Organisational influences

The future of mining is widely thought of to be uncertain (Deloitte, 2022; PwC, 2017). Uncertainty, or a 'lack of predictability in work tasks and requirements' (Wall et al., 2002, p. 151), arises from a lack of information, and can lead to increased stress and decreased performance at work because employees need to expand more effort to gather information in order to take appropriate actions (Avgoustaki, 2016). However, there is evidence that organisational influences, such as HR policies, can

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help to attenuate the effects of an uncertain work context (Avgoustaki, 2016), such as uncertainty related to work in the future mine. Indeed, discussions of organisational (and by extension, industrial) implementation of new technologies generally point to the fact that open communication and organisational trust are important factors in predicting success of technological change (Vanhala & Ritala, 2016; Worley et al., 1999). Therefore, while the future of mining may bring uncertainties and related resistance, organisations are well placed to support employees through the transitions and the increasingly fast-paced rate of change at work.

Higher-level external influences

Nationally, Australia has a significant amount of critical mineral resources – and the potential to mine these resources – compared to many other countries, ranking in the top five globally in terms of critical mineral resources such as antimony, cobalt, lithium, manganese ore, niobium, tungsten and vanadium, with the potential for far more undiscovered minerals (Department of Industry, Science and Resources, n.d.). In 2021, the Australian Government forecasted that the global rare earth elements market was expected to grow to around US$12 billion within the decade (Office of the Chief Economist, 2021). Further, with the Australian Government pursuing foreign investment in Australia's critical minerals (Department of Industry, Science and Resources, n.d.), it is extremely likely that the advent of work in the future mine site as previously described will continue to accelerate.

Transitioning the workforce into the future of work in mining

The transition to the future of work in mining not only requires workers at the individual level to engage in lifelong learning, but also requires organisations to engage in strategies to upskill and reskill workers to ensure currency and viability of workers in the future landscape – particularly workers whose roles include a large proportion of menial tasks that are very likely to be automated, as we discussed above. Further, these changes pose new challenges for the mining industry on the whole in terms of education and training, not only for workers, but also within the regulatory bodies. In this section, we expand upon how the landscape and needs of the workforce are likely to shift to meet the demands of the future of work in mining.

A changing demographic

As the work in mining itself changes, the demographics of the workforce will change, and people will need to work together in new ways, as we will describe below. However, one thing is clear – with humans existing at the core of the human-technological systems, it is critical for workers to develop the interpersonal skills which enable effective collaboration and development of healthy working relationships with co-workers of different backgrounds. These skills include the ability to appreciate diversity, acknowledge and accept different points of view and ways of thinking, as well as to coordinate effectively with others in order to achieve collective organisational and team goals.

Towards a more gender diverse workforce

The consensus appears to be that the future of work in mining will see a shift away from the blue-collar context into more centralised operating centres (Gallardo et al., 2020; MST, 2021). One aspect of change associated with this shift is that the majority of mining operations no longer need to be physically located in mine sites, which are typically in remote and inaccessible locations (Choudhury & Soni, 2020). In contrast, central operating centres can be and have been based in head offices (Gleeson, 2019) and inner-city offices (Australian Mining, 2016). Such centres are more geographically accessible for a larger part of the workforce, since there is no longer a requirement to travel long distances to places of work (as is in the case of FIFO

workers; Dorow & Jean, 2022) and being away from family commitments for extended periods of time. Further, the work undertaken in centralised operating centres is likely to be far less physically demanding compared to work on the mine site. Abrahamsson and Johansson (2021) suggested that such technology-driven changes to the way work is organised can therefore lead to a more gender balanced workforce. The shift to a more office-based work also allows for organisations to consider flexible working arrangements, thereby further attracting females to the role – a strategy that increases the pool of talent and potential workers (Olsen et al., 2016). Indeed, since BHP's implementation of an integrated remote operations centre located in Brisbane's inner city, they have achieved an unprecedented level of gender balance in the mining industry. Of 177 controllers employed at their integrated remote operations centre, 53% of controllers are female (BHP, n.d.). Gender diversity in the mining industry is linked to higher safety and operational performance (Mackenzie, 2019; McKinsey & Company, 2021b). A more gender balanced workforce can also temper the "macho-masculinity" that has become synonymous with the mining industry (Abrahamsson & Johansson, 2021), which is linked to other aspects of well-being, such as mental health (see Chapter 1) and sexual harassment and assault (see Chapter 2).

An aging workforce
Considering the declining birth rate coupled with an increasing life expectancy and changing welfare policies, it is undeniable that the population, and hence workforce, is ageing. Many workers will be able to work to an older age (Centre for Transformative Work Design, 2019). However, within the mining industry, the proportion of workers (drillers, miners and shot firers) in the 60-64 (3.9% mining, 6% overall) and 65 and over (1.4% mining, 4.2% overall) age brackets are significantly smaller than the overall workforce average (based on data from 2016; National Skills Commission, n.d.). This may be due to the work of operators being more physically demanding, and in turn perceived as a job that people "can be simply 'too old' to do" (Hatch, 2022).

Mature workers have a distinct range of experiences and an extensive knowledge and skill base (Andrei et al., 2019; Parker & Andrei, 2020). These knowledge, skills and abilities have been cultivated over decades of work experience, and are relevant and invaluable to succeeding at work tasks which are complex or require innovation (Parker & Andrei, 2020). Similar to the changes outlined above on a more gender balanced workforce, it is likely that technological advancements in the mining industry can lead to a higher rate of retention of mature workers in mining through the shift away from physically demanding and dangerous work to a job that is more knowledge-based.

Upskilling and reskilling
As technology advances, the focus on the human workforce and attributes (which include attitudes and skills) become of utmost importance. As we have discussed above, the menial tasks commonly associated with aspects of operator work are most likely to be automated (Parker & Grote, 2020). This creates an urgent need to support the reskilling of these workers to proactively prepare them to take up future roles. Workers will need a revised set of skills to meet the evolving nature of work, in which they are able to value-add beyond automated systems, operate effectively in a digital environment, and continually adapt to new technologies, ways of working, and even the creation of new jobs. Identifying the attributes required for workers to succeed in the future of work – and supporting them to develop these attributes – will become critical for an organisation's success.

Research in other industries such as aviation and surgical teams (Cochrane et al., 2017) have led to the use of non-technical skills to help teams to navigate the uncertain and hard to foresee aspects of such safety critical work environments. Non-technical

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skills (also known as crew resource management) refer to the cognitive, social, and personal resource skills which complement the extensive technical skills of teams, and contribute to safe and effective task performance (Flin et al., 2003). McKinsey & Company (2021a) defined a taxonomy of 56 qualities that the future worker will need to thrive in the future of work (in general), spanning across cognitive, interpersonal, digital, and self-leadership qualities. Further analyses of these qualities showed that the top three qualities predicting better outcomes for employment include synthesising messages (the ability to concisely communicate information), coping with uncertainty (the ability to operate effectively in uncertain situations or when things do not go to plan), and adaptability (the ability to be open to change how things are done, even if it requires effort or learning new skills; McKinsey & Company, 2021a). Similarly, the top three qualities predicting better job satisfaction were self-confidence (trusting one's abilities), coping with uncertainty, and self-motivation and wellness (maintaining motivation by pursuing long-term goals and appropriate recovery styles; McKinsey & Company, 2021a). Interestingly, coping with uncertainty appeared to underlie better outcomes for both employment and job satisfaction. This, coupled the uncertainties that characterise the increased focus on critical minerals, suggests that the skill of coping with uncertainty is a quality that is very important for the future of work. However, McKinsey & Company (2021a) further found that in a desktop scan of adult-training courses, there appeared to be a dearth of programs aimed at developing workers' abilities to cope with uncertainty (such programs were 20 times less common than those related to communication courses, for example). Therefore, it is important for organisations, governments, and training partners to support the upskilling and reskilling of workers in both technical skills required to succeed at the mining jobs of the future, as well as developing their qualities such as adaptability and coping with uncertainty, that will be imperative for thriving in the future of mining.

The future of teamwork in mining

Advancement of technology is also suggested to change the way that teams work. One aspect of the changing team dynamic is the growth of increasingly interconnected teams and networked operations. For example, integrated operation centres can centralise the oversight of traditionally distinct and geographically separate parts of the business supply chain, such as the mine operations, processing, haulage and port operations, thereby bringing together teams who would otherwise be working in silos, and increase interdependencies. Workers in the future mines will need interpersonal skills to support the development of healthy working relationships and effective teamwork.

Another aspect in which the future of work might affect teamwork is the creation of "superteams", where the capabilities of human and technology are highly integrated to the extent that technology is seen as a team member and collaborator, rather than simply as a tool (Deloitte, 2021). Building on the previously examined idea that a diverse workforce results in better outcomes as a result of more diverse ways of thinking, artificial intelligence, when seen as an equal team member, can bring its own "thinking" to the team, thereby yielding similar benefits of a human-diverse team (Guszcza & Schwartz, 2020). However, extensive skills, training, and indeed a paradigm shift are required to bring the vision of the "superteam" to reality. McKinsey & Company (2021a) identified a set of qualities of utmost importance to the future worker, including programming literacy, defined as "the ability to understand the principles of software development and coding", as well as computational and algorithmic thinking, defined as "the ability to translate real problems into models of algorithms that people and computers can easily process". In order for "superteams" to be successful, workers need to be proficient in both understanding the software as well as the algorithms by which their artificial intelligence team member "thinks".

Through developing digital skills, workers are more likely to integrate seamlessly with technology to harness the full potential of the human-technological system.

Summary

The future of mining is likely to be characterised by uncertainty related to technological advances and different work requirements and processes (in the case of critical minerals). It is therefore important to consider how work itself might change vis-à-vis these changes to the industry, and how organisations can best support workers to meet the ever-evolving challenges in order to protect their well-being and safety, whilst retaining a competitive edge. At each stage of technological implementation, organisations can choose human-centric systems which put human users at the core of the system, or adopt a techno-centric, "one-size-fits-all" approach which neglects the user perspective. Organisational and local contexts can also heavily influence the successful integration of technology into the workforce and support workers through meeting the novel challenges that characterises the future of mining, through transparent communication and a cultural shift. While the specific details of how the future mines will look like are uncertain, the success of the future mines depends on organisational decisions about work and workers made today.

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References

References

Abrahamsson, L., & Johansson, J. (2021). Can new technology challenge macho-masculinities? The case of the mining industry. *Mineral Economics, 34*(2), 263-275. https://doi.org/10.1007/s13563-020-00221-8

Acemoglu, D., & Autor, D. (2011). Skills, tasks and technologies: Implications for employment and earnings. In D. Card & O. Ashenfelter (Eds.), *Handbook of Labor Economics (Vol. 4*, part B, pp. 1043-1171). Elsevier.

Ahmad, A. (2017). Prevalence and predictors of occupational stress among quarry workers in rural Rajasthan, India. *Journal of Public Mental Health, 16*(4), 132-143. https://doi.org/10.1108/JPMH-03-2017-0008

American Psychological Association. (n.d.). *APA Dictionary of Psychology - Individual Differences*. https://dictionary.apa.org/individual-differences

Andrei, D. M., Parker, S. K., Constantin, A., Baird, M., Iles, L., Petery, G., Zoszak, L., Williams, A., & Chen, S. (2019). *Maximising Potential: Findings from the Mature Workers in Organisations Survey (MWOS)*. Centre for Excellence in Population Ageing Research. https://cepar.edu.au/sites/default/files/Findings-from-Mature-Workers-in-Organisations-Survey-Dec-2019.pdf

Arksey, H. & O'Malley, L. (2005) Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology, 8*(1), 19-32. https://doi.org/10.1080/1364557032000119616

Arthur-Holmes, F., & Busia, K. A. (2022). Safety concerns and occupational health hazards of women in artisanal and small-scale mining in Ghana. *Extractive Industries and Society – An International Journal, 10*(9), Article 101079. https://doi.org/10.1016/j.exis.2022.101079

Asare-Doku, W., James, C., Rich, J. L., Amponsah-Tawiah, K., & Kelly, B. (2022). "Mental health is not our core business": A qualitative study of mental health supports in the Ghanaian mining industry. *Safety Science, 145*, e105484. https://doi.org/10.1016/j.ssci.2021.105484

Asare-Doku, W., Rich, J., Kelly, B., & James, C. (2020). Mental health interventions in the mining industry: A narrative review. *Mental Health Review Journal, 25*(2), 153-167. https://doi.org/10.1108/MHRJ-10-2019-0039

Asare-Doku, W., Rich, J. L., Kelly, B., Amponsah-Tawiah, K., & James, C. (2021). Mental health and mining: The Ghanaian gold mining story. *International Archives of Occupational and Environmental Health, 94*(6), 1353-1362. https://doi.org/10.1007/s00420-021-01726-7

Australian Bureau of Statistics. (2008). *Australian and New Zealand Standard Industrial Classification (ANZSIC), 2006 (Revision 1.0)*. https://www.abs.gov.au/ausstats/abs@.nsf/0/8322BF041248E73DCA25711F00146DA6?opendocument

Australian Bureau of Statistics. (2013). *Australian social trends: Towns of the mining boom*. https://www.abs.gov.au/ausstats/abs@.nsf/lookup/4102.0main+features10april+2013

Australian Bureau of Statistics. (2015). *Kessler psychological distress scale-10 (K10)*. https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/4363.0~2014-15~Main%20Features~Kessler%20Psychological%20Distress%20Scale-10%20(K10)~35

Australian Bureau of Statistics. (2016). *Personal Safety, Australia*. ABS. https://www.abs.gov.au/statistics/people/crime-and-justice/personal-safety-australia/2016

Australian Bureau of Statistics. (2018). *Defining family, domestic, and sexual violence*. https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20 Subject/4533.0~2018~Main%20F eatures~Defining%20Family,%20Domestic,%20 and%20Sexual%20Violence~4

Australian Human Rights Commission. (2018). *Everyone's business: Fourth national survey on sexual harassment in Australian workplaces*. https://humanrights.gov.au/ our-work/sex-discrimination/publications/everyones-business-fourth-national-survey- sexual

Australian Human Rights Commission. (2020). *Respect@Work: National inquiry into sexual harassment in Australian workplaces*. https://humanrights.gov.au/our-work/ sex-discrimination/publications/respectwork-sexual-harassment-national-inquiry- report-2020

Australian Mining. (2016). *BHP launch coal remote operations centre*. https://www. australianmining.com.au/news/bhp-launch-coal-remote-operations-centre/

Australian Trade and Investment Commission. (2021). *Australian critical minerals prospectus 2021*. https://www.austrade.gov.au/ArticleDocuments/5572/australian_ critical_minerals_prospectus.pdf

Avery, A., Betts, D., Whittington, A., Heron, T., Wilson, S., & Reeves, J. (1998). The mental and physical health of miners following the 1992 national pit closure programme: A cross sectional survey using General Health Questionnaire GHQ-12 and Short Form SF-36. *Public Health, 112*(3), 169-173. https://doi.org/10.1038/sj.ph.1900456

Avgoustaki, A. (2016). Work uncertainty and extensive work effort: The mediating role of human resource practices. *Industrial and Labor Relations Review, 69*(3), 656-682. http://doi.org/10.1177/0019793915614584

Bashwira, M. R., Hilhorst, D., & van der Haar, G. (2014). Not only a man's world: Women's involvement in artisanal mining in eastern DRC. *Resources Policy, 40*, 109- 116. https://doi.org/10.1016/j.resourpol.2013.11.002

Bashwira, M. R., & van der Haar, G. (2020). Necessity or choice: Women's migration to artisanal mining regions in eastern DRC. *Canadian Journal of African Studies, 54*(1), 79-99. https://doi.org/10.1080/00083968.2019.1674170

Beane, M., & Orlikowski, W. J. (2015). What difference does a robot make? The material enactment of distributed coordination. *Organization Science, 26*(6), 1553-1573. https:// doi.org/10.1287/orsc.2015.1004

BHP. (2022). *BHP unveils world-first automated shiploaders* [Press release]. https:// www.bhp.com/news/media-centre/releases/2022/06/bhp-unveils-world-first- automated-shiploaders

BHP. (n.d.). *A new approach to recruitment*. https://www.bhp.com/news/case- studies/2017/09/a-new-approach-to-recruitment

Billings, C. E. (1991). *Human-centered aircraft automation: A concept and guidelines* (U.S. Patent No. NAS 1.15:103885). National Aeronautics and Space Administration, Ames Research Center.

Botha, D. (2016). Women in mining still exploited and sexually harassed. *SA Journal of Human Resource Management, 15*, Article 753. https://doi.org/10.4102/sajhrm.v14i1.753

Bowers, J. (2015). *Submission to the Education and Health Standing Committee: Inquiry into mental health impacts of FIFO work arrangements*. Australasian Centre for Rural & Remote Mental Health. https://www.parliament.wa.gov.au/Parliament/Commit. nsf/(Evidence+Lookup+by+Com+ID)/72E6F5EA6DC35CC848257E200028C12D/$file/14498465.pdf

Bowers, J., Lo, J., Miller, P., Mawren, D., & Jones, B. (2018). Psychological distress in remote mining and construction workers in Australia. *Medical Journal of Australia, 208*(9), 391-397. https://doi.org/10.5694/mja17.00950

Bowling, N. A., & Beehr, T. A. (2006). Workplace harassment from the victim's perspective: A theoretical model and meta-analysis. *Journal of Applied Psychology, 91*(5), 998-1012. https://doi.org/10.1037/0021-9010.91.5.998

Boyd, J. A., & Huettinger, M. (2019). Smithian insights on automation and the future of work. *Futures, 111*, 104-115. https://doi.org/10.1016/j.futures.2019.06.002

Boyer, K., Mayes, R., & Pini, B. (2017). Narrations and practices of mobility and immobility in the maintenance of gender dualisms. *Mobilities, 12*(6), 847-860. https://doi.org/10.1080/17450101.2017.1292027

Brynjolfsson, E., Mitchell, T., & Rock, D. (2018). What can machines learn, and what does it mean for occupations and the economy? *AEA Papers and Proceedings, 108*, 43-47.

Buss, D. (2018). Conflict minerals and sexual violence in Central Africa: Troubling research. *Social Politics, 25(4)*, 545-567. https://doi.org/10.1093/sp/jxy034

Caminiti, S. (2018, March 13). *AT&T's $1 billion gambit: Retraining nearly half its workforce for jobs of the future*. CNBC. https://www.cnbc.com/2018/03/13/atts-1-billion-gambit-retraining-nearly-half-its-workforce.html

Carlisle, K. N., & Parker, A. W. (2014). Psychological distress and pain reporting in Australian coal miners. *Safety and Health at Work, 5*(4), 203-209. https://doi.org/10.1016/j.shaw.2014.07.005

Centre for Transformative Work Design. (2019). *The ageing workforce: Maximising the productivity, health and wellbeing of mature workers*. https://research.curtin.edu.au/businesslaw/wp-content/uploads/sites/5/2019/03/FOWI-Research-Poster-Ageing.pdf

Chamber of Minerals and Energy of Western Australia. (2019). *Diversity in the Western Australian Resources Sector 2019 Report*. https://www.cmewa.com.au/wp-content/uploads/2020/05/Diversity-in-the-Western-Australian-Resources-Sector-2019-Report-FINAL-2.pdf

Chen, S.-P., Chang, W.-P., & Stuart, H. (2020). Self-reflection and screening mental health on Canadian campuses: Validation of the mental health continuum model. *BMC Psychology, 8*(1), Article 76. https://10.1186/s40359-020-00446-w

Choudhury, A., & Soni, L. M. (2020). *Remote operation centre: Enabling digital disruption in the mining industry*. Infosys. https://www.infosys.com/engineering-services/white-papers/documents/remote-operation-center.pdf

Ciftci, E. E., Barreto, M., Doyle, D. M., van Breen, J., & Darden, S. (2020). Distancing or drawing together: Sexism and organisational tolerance of sexism impact women's social relationships at work. *European Journal of Social Psychology, 50*(6), 1157-1172. https://doi.org/10.1002/ejsp.2695

Cochrane, B. S., Hagins Jr, M., Picciano, G., King, J. A., Marshall, D. A., Nelson, B., & Deao, C. (2017). High reliability in healthcare: Creating the culture and mindset for patient safety. *Healthcare Management Forum, 30*(2), 61-68. https://doi.org/10.1177/0840470416689314

Commission for Occupational Safety and Health. (2019). *Mentally healthy workplaces for fly-in fly-out (FIFO) workers in the resources and construction sectors*. Department of Mines, Industry Regulation and Safety, Western Australia. https://www.dmp.wa.gov.au/Documents/Safety/MSH_MHW_FIFO_COP.pdf

Considine, R., Tynan, R., James, C., Wiggers, J., Lewin, T., Inder, K., Perkins, D., Handley, T., & Kelly, B. (2017). The contribution of individual, social and work characteristics to employee mental health in a coal mining industry population. *PLOS One, 12*(1), e0168445. https://doi.org/10.1371%2Fjournal.pone.0168445

Conversy, S., Chatty, S., Gaspard-Boulinc, H., & Vinot, J.-L. (2014). The accident of flight AF447 Rio-Paris: A case study for HCI research. *IHM'14: Proceedings of the 26th Conference on l'Interaction Homme-Machine*, 60-69. https://doi.org/10.1145/2670444.2670459

Conway, M. (2000). On sex roles and representations of emotional experience: Masculinity, femininity, and emotional awareness. *Sex Roles, 43*, 687-698. https://doi.org/10.1023/a:1007156608823

Corrêa, O. C. (2021). *Remote operating centers: The future of mining industries. LinkedIn Pulse*. https://www.linkedin.com/pulse/remote-operating-centers-future-mining-industries-carneiro-corrêa/

Corrigan, P. W. (2000). Mental health stigma as social attribution: Implications for research methods and attitude change. *Clinical Psychology: Science and Practice, 7(1)*, 48-67. https://doi.org/10.1093/clipsy.7.1.48

Critical Technologies Policy Coordination Office. (n.d.). *Critical minerals extraction and processing*. https://www.pmc.gov.au/sites/default/files/publications/ctpco-tech-cards-critical-minerals-extraction-processing-aust.pdf

Crum, R. M., Mojtabai, R., Lazareck, S., Bolton, J. M., Robinson, J., Sareen, J., Green, K. M., Stuart, E. A., La Flair, L., & Alvanzo, A. A. (2013). A prospective assessment of reports of drinking to self-medicate mood symptoms with the incidence and persistence of alcohol dependence. *JAMA Psychiatry, 70*(7), 718-726. https://doi.org/10.1001%2Fjamapsychiatry.2013.1098

CSIRO. (2022). *Seven megatrends that will shape the next 20 years* [Press release]. https://www.csiro.au/en/news/news-releases/2022/seven-megatrends-that-will-shape-the-next-20-years

Deloitte. (2021). *The social enterprise in a world disrupted: Leading the shift from survive to thrive*. 2021. https://www2.deloitte.com/content/dam/insights/us/articles/6935_2021-HC-Trends/di_human-capital-trends.pdf

Deloitte. (2022). *Tracking the trends 2022: The top 10 issues shaping the future of mining*. https://www2.deloitte.com/au/en/pages/energy-and-resources/articles/tracking-the-trends.html

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied Psychology, 86*(3), 499-512. https://doi.org/10.1037/0021-9010.86.3.499

Department of Industry, Science, Energy and Resources. (n.d.). *Investing in Australia's critical minerals*. https://www.industry.gov.au/mining-oil-and-gas/minerals/critical-minerals/investing-critical-minerals-australia

Donaldson, C. (2019). *Meet your future colleague: The top 20 skills needed for the future of work*. Inside HR. https://www.insidehr.com.au/future-colleague-top-20-skills-future-of-work/

Dorney, G. (2019). *There's a right and wrong way to automate staff out of a job*. HRM Online. https://www.hrmonline.com.au/change-management/right-way-automate-staff-job/

Dorow, S., & Jean, S. (2022). Managing liminal time in the fly-in fly-out work camp. *Human Relations, 75*(4), 681-704. https://doi.org/10.1177/0018726721989792

Education and Health Standing Committee. (2015). *The impact of FIFO work practices on mental health*. Western Australia Legislative Assembly. https://www.parliament.wa.gov.au/Parliament/commit.nsf/ID)/2E970A7A4934026448257E67002BF9D1/$file/20150617%20-%20Final%20Report%20w%20signature%20for%20website.pdf

Ebert, A., & Strehlow, K. (2016). Does on-site chaplaincy enhance the health and well being of fly-in, fly-out (FIFO) personnel? *Health Promotion Journal of Australia, 28*(2), 118-122. https://doi.org/10.1071/he16019

Farrelly, C., & Records, L. (2007, October 2-4). *Remote operations centres - Lessons from other industries* [Paper presentation]. 2007 Australian Mining Technology Conference, Brisbane, Australia.

Ferràs-Hernández, X. (2018). The future of management in a world of electronic brains. *Journal of Management Inquiry, 27*(2), 260-263. https://doi.org/10.1177/1056492617724973

Flin, R., & Fruhen, L. (2015). Managing safety: Ambiguous information and chronic unease. *Journal of Contingencies and Crisis Management, 23*(2), 84-89. http://doi.org/10.1111/1468-5973.12077

Flin, R., Martin, L., Goeters, K.-M., Hörmann, H.-J., Amalberti, R., Valot, C., & Nijhuis, H. (2003). Development of the NOTECHS (non-technical skills) system for assessing pilots' CRM skills. *Human Factors and Aerospace Safety, 3*(2), 97-119.

Fortescue. (2021). *Fortescue deploys autonomous light vehicles at Chichester Hub*. https://www.fmgl.com.au/in-the-news/media-releases/2021/02/15/fortescue-deploys-autonomous-light-vehicles-at-chichester-hub

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change, 114*, 254-280. https://doi.org/10.1016/j.techfore.2016.08.019

Gallardo, R., Goddard, D., Görner, S., & Rubinstein, B. (2020). *Remote operating centers in mining: Unlocking their full potential*. https://www.mckinsey.com/industries/metals-and-mining/our-insights/remote-operating-centers-in-mining-unlocking-their-full-potential

Geoscience Australia. (n.d.). *Critical minerals at Geoscience Australia*. https://www.ga.gov.au/scientific-topics/minerals/critical-minerals#:~:text=including%20critical%20minerals.-,What%20is%20a%20critical%20mineral%3F,supply%20chains%20could%20be%20disrupted

Gilmore, W., Liang, W. B., & Chikritzhs, T. (2016). The wild west: Associations between mining and violence in Western Australia. *Australian Journal of Rural Health, 24*(2), 136-143. https://doi.org/10.1111/ajr.12228

Gleeson, D. (2019). *Barminco turns Perth head office into remote operations centre. International Mining*. https://im-mining.com/2019/12/03/barminco-turns-perth-head-office-remote-operations-centre/

Grote, G., & Baitsch, C. (1991). Reciprocal effects between organizational culture and the implementation of an office communication system: A case study. *Behaviour & Information Technology, 10*(3), 207-218. https://doi.org/10.1080/01449299108924283

Grounds, C. B., & Ensing, A. R. (2000). Automation distrust impacts on command and control decision time. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 44*(22), 855-858. https://doi.org/10.1177/154193120004402293

Guszcza, J., & Schwartz, J. (2020). *Superminds, not substitutes: Designing human-machine collaboration for a better future of work*. Deloitte Review. https://www2.deloitte.com/content/dam/insights/us/articles/6672_superminds-not-substitutes/DI_DR27-Superminds.pdf

Hackman, J. R., & Oldham, G. R. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance, 16*(2), 250-279. https://doi.org/10.1016/0030-5073(76)90016-7

Haddaway, N. R., Collins, A. M., Coughlin, D., & Kirk, S. (2015). The role of Google Scholar in evidence reviews and its applicability to grey literature searching. *PLOS One, 10*(9), e0138237. https://doi.org/10.1371/journal.pone.0138237

Hall, W., Degenhardt, L., & Teesson, M. (2009). Understanding comorbidity between substance use, anxiety and affective disorders: Broadening the research base. *Addictive Behaviors, 34*(6-7), 526-530. https://doi.org/10.1016/j.addbeh.2009.03.010

Hatch, D. (2022). *Am I too old for a job in the mining industry?* Mining People International. https://www.mpirecruitment.au/news/am-i-too-old-for-a-job-in-the-mining-industry

Hill, C., Namara, C., Orcaya, J., Bogrand, A., & Sellwood, S. A. (2021). Hidden in plain sight: Gender analysis of the environmental and social impact assessment of the East African Crude Oil Pipeline. *Impact Assessment and Project Appraisal, 39*(3), 229-239. https://doi.org/10.1080/14615517.2021.1904696

Hislop, D., Axtell, C., Collins, A., Daniels, K., Glover, J., & Niven, K. (2015). Variability in the use of mobile ICTs by homeworkers and its consequences for boundary management and social isolation. *Information and Organization, 25*(4), 222-232. https://doi.org/10.1016/j.infoandorg.2015.10.001

Huang, M., & Rust, R. T. (2018). Artificial intelligence in service. *Journal of Service Research, 21*(2), 155-172. https://doi.org/10.1177/1094670517752459

Huggins, C., Buss, D., & Rutherford, B. (2017). A 'cartography of concern': Place-making practices and gender in the artisanal mining sector in Africa. *Geoforum, 83,* 142-152. https://doi.org/10.1016/j.geoforum.2016.09.009

Hunter Institute of Mental Health. (2016). *Partners in mining*. https://www.coalservices.com.au/wp-content/uploads/2016/08/Project-No-20626-Partners-in-Mining-Final-Report.pdf

Itoh, M., & Inagaki, T. (2019). *A microworld approach to identifying issues of human-automation systems design for supporting operator's situation awareness*. In O. Katai (Ed.), Current research of the Human Interface Society (pp. 3-24). CRC Press.

James, C., Tynan, R., Roach, D., Leigh, L., Oldmeadow, C., Rahman, M., & Kelly, B. (2018). Correlates of psychological distress among workers in the mining industry in remote Australia: Evidence from a multi-site cross-sectional survey. *PLOS One, 13*(12), e0209377. https://doi.org/10.1371/journal.pone.0209377

James, C. L., Tynan, R. J., Bezzina, A. T., Rahman, M. M., & Kelly, B. J. (2021). Alcohol consumption in the Australian mining industry: The role of workplace, social, and individual factors. *Workplace Health & Safety, 69*(9), 423-434. https://doi.org/10.1177/21650799211005768

Jenkins, K. (2014). Women, mining and development: An emerging research agenda. *The Extractive Industries and Society, 1*(2), 329-339. https://doi.org/10.1016/j.exis.2014.08.004

Joaquim, A. C., Lopes, M., Stangherlin, L., Castro, K., Ceretta, L. B., Longen, W. C., Ferraz, F., & Perry, I. D. S. (2018). Mental health in underground coal miners. *Archives of Environmental & Occupational Health, 73*(6), 334-343. https://doi.org/10.1080/19338244.2017.1411329

Kansake, B. A., Sakyi-Addo, G. B., & Dumakor-Dupey, N. K. (2021). Creating a gender-inclusive mining industry: Uncovering the challenges of female mining stakeholders. *Resources Policy, 70*(20), Article 101962. https://doi.org/10.1016/j.resourpol.2020.101962

Kelly, J. T. D., King-Close, A., & Perks, R. (2014). Resources and resourcefulness: Roles, opportunities and risks for women working at artisanal mines in South Kivu, Democratic Republic of the Congo. *Futures, 62*, 95-105. https://doi.org/10.1016/j.futures.2014.04.003

Kessler, R. C., Andrews, G., Colpe, L. J., Hiripi, E., Mroczek, D. K., Normand, S. L. T., Walters, E. E., & Zaslavsky, A. M. (2002). Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological Medicine, 32*(6), 959-976. https://doi.org/10.1017/S0033291702006074

Kim, T. J., & von dem Knesebeck, O. (2016). Perceived job insecurity, unemployment and depressive symptoms: A systematic review and meta-analysis of prospective observational studies. *International Archives of Occupational and Environmental Health, 89*(4), 561-573. https://doi.org/10.1007/s00420-015-1107-1

King, M. (2022). *Sexual harassment and assault in the FIFO mining industry must stop*. https://www.minister.industry.gov.au/ministers/king/media-releases/sexual-harassment-and-assault-fifo-mining-industry-must-stop

Knapp, D. E. (2016). Sexual harassment and the real north country: Revelations of an expert witness. *Employee Responsibilities and Rights Journal, 28*(1), 1-22. https://doi.org/10.1007/s10672-015-9269-2

Kotsadam, A., Østby, G., & Rustad, S. A. (2017). Structural change and wife abuse: A disaggregated study of mineral mining and domestic violence in sub-Saharan Africa, 1999–2013. *Political Geography, 56*, 53-65. https://doi.org/10.1016/j.polgeo.2016.11.004

Lahiri-Dutt, K. (2022). New directions in research on women and gender in extractive industries. *The Extractive Industries and Society, 9*, 101048. https://doi.org/10.1016/j.exis.2022.101048

Langdon, R. R., Biggs, H. C., & Rowland, B. (2016). Australian fly-in, fly-out operations: Impacts on communities, safety, workers and their families. *Work, 55*(2), 413-427. https://doi.org/10.3233/wor-162412

Leach, D., Hagger-Johnson, G., Doerner, N., Wall, T., Turner, N., Dawson, J., & Grote, G. (2013). Developing a measure of work uncertainty. *Journal of Occupational and Organizational Psychology, 86*(1), 85-99. https://doi.org/10.1111/joop.12000

Legislative Assembly Community Development Justice Standing Committee. (2022). *'Enough is Enough' - Sexual harassment against women in the FIFO mining industry.* https://www.parliament.wa.gov.au/parliament/commit.nsf/(Report+Lookup+by+Com+ID)/EF1DF1A3F5DF74A848258869000E6B32/$file/20220621%20-Report%20No%202.pdf

Li, Y., Chen, P. Y., Tuckey, M. R., McLinton, S. S., & Dollard, M. F. (2019). Prevention through job design: Identifying high-risk job characteristics associated with workplace bullying. *Journal of Occupational Health Psychology, 24*(2), 297-306. https://doi.org/10.1037/ocp0000133

Lifeline WA. (2013). *FIFO/DIDO Mental Health Research Report 2013.* www.aasw.asn.au%2Fdocument%2Fitem%2F5136&usg=AOvVaw1sTtW4hVvd6xiteH8XF667

Liu, L., Wen, F., Xu, X., & Wang, L. (2015). Effective resources for improving mental health among Chinese underground coal miners: Perceived organizational support and psychological capital. *Journal of Occupational Health, 57*(1), 58-68. https://doi.org/10.1539/joh.14-0082-oa

Mackenzie, A. (2019). *The gender equation.* https://www.bhp.com/news/prospects/2019/10/the-gender-equation

Mahalik, J. R., Good, G. E., & Englar-Carlson, M. (2003). Masculinity scripts, presenting concerns, and help seeking: Implications for practice and training. *Professional Psychology: Research and Practice, 34*(2), 123-131. https://doi.org/10.1037/0735-7028.34.2.123

Manning, S. M. (2016). Intersectionality in resource extraction: A case study of sexual violence at the Porgera mine in Papua New Guinea. *International Feminist Journal of Politics, 18*(4), 574-589. https://doi.org/10.1080/14616742.2016.1189670

Mancini, L., & Sala, S. (2018). Social impact assessment in the mining sector: Review and comparison of indicators frameworks. *Resources Policy, 57*, 98-111. https://doi.org/10.1016/j.resourpol.2018.02.002

March, C., Smyth, I., & Mukhopadhyay, M. (1999). *A guide to gender analysis frameworks.* Oxford (UK): Oxfam. Retrieved from: https://policy-practice.oxfam.org.uk/publications/a-guide-to-genderanalysis-frameworks-115397

Maqubela, L., Ndanduleni D., & Nishimwe-Niyimbanira, R. (2020). Destablising masculinities: Perceptions on the gendered division of labour in the mining sector in Phalaborwa Limpopo province. *Gender & Behaviour, 18*(4), 16944-16956. https://www.proquest.com/scholarly-journals/destabilising-masculinities-perceptions-on/docview/2477409192/se-2

McKinsey & Company. (2021a). *Defining the skills citizens will need in the future world of work.* https://www.mckinsey.com/industries/public-and-social-sector/our-insights/defining-the-skills-citizens-will-need-in-the-future-world-of-work

McKinsey & Company. (2021b). *Why women are leaving the mining industry and what mining companies can do about it.* https://www.mckinsey.com/industries/metals-and-mining/our-insights/why-women-are-leaving-the-mining-industry-and-what-mining-companies-can-do-about-it

McLaughlin, H., Uggen, C., & Blackstone, A. (2012). Sexual Harassment, Workplace Authority, and the Paradox of Power. *American Sociological Review, 77*(4), 625-647. https://doi.org/10.1177/0003122412451728

Mclean, K. N. (2012). Mental health and well-being in resident mine workers: Out of the fly-in fly-out box. *Australian Journal of Rural Health, 20*(3), 126-130. https://doi.org/10.1111/j.1440-1584.2012.01267.x

McPhedran, S., & De Leo, D. (2014). Relationship quality, work-family stress, and mental health among Australian male mining industry employees. *Journal of Relationships Research, 5*, e.3. https://doi.org/10.1017/jrr.2014.3

Me too Mining. (2022). *Me too Mining Association*. https://www.metoomining.com/

Mette, J., Robelski, S., Kirchhöfer, M., Harth, V., & Mache, S. (2019). Living the 14/14 schedule: Qualitative analysis of the challenges and coping strategies among families of offshore wind workers. *International Journal of Environmental Research and Public Health, 16*(2), 241-260. https://doi.org/10.3390/ijerph16020241

Molek-Winiarska, D., & Żołnierczyk-Zreda, D. (2018). Application of mindfulness-based stress reduction to a stress management intervention in a study of a mining sector company. *International Journal of Occupational Safety and Ergonomics, 24*(4), 546-556. https://doi.org/10.1080/10803548.2018.1452843

Mościcka-Teske, A., Sadłowska-Wrzesińska, J., Butlewski, M., Misztal, A., & Jacukowicz, A. (2017). Stressful work characteristics, health indicators and work behavior: The case of machine operators. *International Journal of Occupational Safety and Ergonomics, 23*(4), 510-518. https://doi.org/10.1080/10803548.2016.1197577

MST. (2021). *The Rise of Remote Operating Centres*. https://mstglobal.com/the-rise-of-remote-operating-centres/

Muro, M., Maxim, R., & Whiton, J. (2019). *Automation and artificial intelligence: How machines are affecting people and places*. Metropolitan Policy Program at Brookings. https://www.brookings.edu/wp-content/uploads/2019/01/2019.01_BrookingsMetro_Automation-AI_Report_Muro-Maxim-Whiton-FINAL-version.pdf

Mwakumanya, M. A., Maghenda, M., & Juma, H. (2016). Socio-economic and environmental impact of mining on women in Kasigau mining zone in Taita Taveta County. *Journal of Sustainable Mining, 15*(4), 197-204. https://doi.org/10.1016/j.jsm.2017.04.001

National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. (2011). *Macondo: The Gulf oil disaster.* http://www.wellintegrity.net/Documents/CCR_Macondo_Disaster.pdf

National Mental Health Commission. (2022). *International Women's Day - Snapshot of women's mental health and wellbeing in Australia*. https://www.mentalhealthcommission.gov.au/News-and-media/media-releases/2022/March/International-Women-s-Day-Snapshot-of-women-s-ment

National Skills Commission. (n.d.). *Labour market insights occupation profile: Drillers, Miners and Shot Firers ANZSCO ID 7122*. https://labourmarketinsights.gov.au/occupation-profile/drillers-miners-and-shot-firers?occupationCode=7122

Neeley, T. B., & Leonardi, P. M. (2018). Enacting knowledge strategy through social media: P assable trust and the paradox of nonwork interactions. *Strategic Management Journal, 39*(3), 922-946. https://doi.org/10.1002/smj.2739

Nel, P., & Kotze, M. (2017). The influence of psychological resources on mineworkers' levels of burnout in a remote and isolated mining town in South Africa. *The Extractive Industries and Society, 4*(4), 885-892. https://doi.org/10.1016/j.exis.2017.10.002

Newman, A., Ucbasaran, D., Zhu, F. E. I., & Hirst, G. (2014). Psychological capital: A review and synthesis. *Journal of Organizational Behavior, 35*(S1), S120-S138. https://doi.org/10.1002/job.1916

Nielsen, M. B., Christensen, J. O., Finne, L. B., & Knardahl, S. (2019). Workplace bullying, mental distress, and sickness absence: The protective role of social support. *International Archives of Occupational and Environmental Health, 93*(1), 43-53. https://doi.org/10.1007/s00420-019-01463-y

O'Mullan, C., Debattista, J., & Keen-Dyer, H. (2018) Moving beyond the individual: Addressing the social determinants of risk taking in mining communities. *Rural Society, 27*(1), 35-51, https://doi.org/10.1080/10371656.2018.1443727

Office of the Chief Economist (2021). *Outlook for selected critical minerals*. Department of Industry, Science, Energy and Resources. https://www.industry.gov.au/sites/default/files/2021-06/outlook_for_selected_critical_minerals_in_australia_2021_report.pdf

Olsen, J. E., Parsons, C. K., Martins, L. L., & Ivanaj, V. (2016). Gender diversity programs, perceived potential for advancement, and organizational attractiveness: An empirical examination of women in the United States and France. *Group & Organization Management, 41*(3), 271-309. https://doi.org/10.1177/1059601115583579

Our Watch. (2019). *Submission to the National Inquiry into sexual harassment in Australian workplaces*. https://media-cdn.ourwatch.org.au/wp-content/uploads/sites/2/2019/11/12234553/Submission-to-the-National-Inquiry-into-Sexual-Harassment-in-Australian-Workplaces-2019.pdf

Parker, S. K. (2014). Beyond motivation: Job and work design for development, health, ambidexterity, and more. *Annual Review of Psychology, 65*(1), 661-691. https://doi.org/10.1146/annurev-psych-010213-115208

Parker, S. K., & Andrei, D. M. (2020). Include, individualize, and integrate: Organizational meta-strategies for mature workers. *Work, Aging and Retirement, 6*(1), 1-7. https://doi.org/10.1093/workar/waz009

Parker, S. K., & Grote, G. (2020). Automation, algorithms, and beyond: Why work design matters more than ever in a digital world. *Applied Psychology, 71*(4), 1171-1204. https://doi.org/10.1111/apps.12241

Parker, S. K., Fruhen, L. F., Burton, C., McQuade, S., Loveny, J., Griffin, M., Page., A., Chikritzhs, T., Crock, S., Jorritsma, K., & Esmond, J. (2018). *Impact of FIFO work arrangements on the mental health and wellbeing of FIFO workers*. Centre for Transformative Work Design. https://www.mhc.wa.gov.au/media/2548/impact-of-fifo-work-arrangement-on-the-mental-health-and-wellbeing-of-fifo-workers-summary-report.pdf

Parker, SK., Jorritsma, K., and Griffin, M. A. (in press). *Shifting the Mental Health Conversation: Present and Future Applications of the "Thrive at Work" Framework*. In P. Brough, E. Gardiner, and K. Daniels. (Eds.), Handbook on Management and Employment Practices, Series in Occupational Health Sciences. Springer Nature: London.

Parker, S. K., Van den Broeck, A., & Holman, D. (2017). Work design influences: A synthesis of multilevel factors that affect the design of jobs. *Academy of Management Annals, 11*(1), 267-308. https://doi.org/10.5465/annals.2014.0054

Perks, R., & Schulz, K. (2020). Gender in oil, gas and mining: An overview of the global state-of-play. *The Extractive Industries and Society, 7*(2), 380-388. https://doi.org/10.1016/j.exis.2020.04.010

Pizarro, J. M., & Fuenzalida, F. A. (2021). Mental health in mine workers: A literature review. *Industrial Health, 59*(6), 343-370. https://doi.org/10.2486/indhealth.2020-0178

Porath, C., Spreitzer, G., Gibson, C., & Garnett, F. G. (2012). Thriving a work: Toward its measurement construct validation, and theoretical refinement. *Journal of Organizational Behavior, 33*(2), 250-275. https://doi.org/10.1002/job.756

PwC. (2017). *We need to talk about the future of mining*. https://www.pwc.com/gx/en/energy-utilities-mining/assets/pwc-mining-transformation-final.pdf

PwC. (2021). *Aussie mine 2021: Critical mining*. https://www.pwc.com.au/industry/mining/aussie-mine-2021/aussie-mine-2021.pdf

Reason, J. (1997). *Managing the risks of organizational accidents*. Routledge. https://doi.org/10.4324/9781315543543

Rio Tinto. (2019a). *Successful rollout of AutoHaul™ positions WA as global rail technology leader* [Press release]. https://www.riotinto.com/en/news/releases/AutoHaul-successfully-deployed

Rio Tinto. (2019b). *Work of the future: How do we build tomorrow's inclusive workplace?* https://www.riotinto.com/-/media/Content/Documents/Sustainability/Communities/Social-and-economic-development/RT-Australia-work-of-the-future.pdf?rev=32d54f0003194b68b7326c9fc96aabd1

Rosette, A.S., de Leon, R.P., Koval, C.Z., Harrison, D.A. (2018). Intersectionality: Connecting experiences of gender with race at work. *Research in Organizational Behavior, 38*, 1-22. https://doi.org/10.1016/J.riob.2018.12.002

Rubin, M., Subasic, E., Giacomini, A., & Paolini, S. (2017). An exploratory study of the relations between women miners' gender-based workplace issues and their mental health and job satisfaction. *Journal of Applied Social Psychology, 47*(7), 400-411. https://doi.org/10.1111/jasp.1244

Runyan, A.S., & Peterson, V.S. (2018). *Global gender issues in the new millennium*. Routledge.

Salas, M. L., Quezada, S., Basagoitia, A., Fernandez, T., Herrera, R., Parra, M., Muñoz, D. M., Weigl, M., & Radon, K. (2015). Working conditions, workplace violence, and psychological distress in Andean miners: A cross-sectional study across three countries. *Annals of Global Health, 81*(4), 465-474. https://doi.org/10.1016/j.aogh.2015.06.002

Samnani, A.-K., & Singh, P. (2012). 20 Years of workplace bullying research: A review of the antecedents and consequences of bullying in the workplace. *Aggression and Violent Behavior, 17*(6), 581-589. https://doi.org/10.1016/j.avb.2012.08.004

Sarter, N. B., Woods, D. D., & Billings, C. E. (1997). *Automation surprises*. In G. Salvendy (Ed.), Handbook of human factors and ergonomics (2nd ed., pp. 1926-1943).

Saunders, S., & Easteal, A. M. P. (2013). The nature, pervasiveness and manifestations of sexual harassment in rural Australia: Does 'masculinity' of workplace make a difference? *Women's Studies International Forum, 40*, 121-131. https://doi.org/10.1016/j.wsif.2013.05.013

Sayers, E., Rich, J., Rahman, M. M., Kelly, B., & James, C. (2019). Does help seeking behavior change over time following a workplace mental health intervention in the coal mining industry? *Journal of Occupational and Environmental Medicine, 61*(6), e282-e290. https://doi.org/10.1097/jom.0000000000001605

Schaufeli, W. B., & Bakker, A. B. (2004). Job demands, job resources, and their relationship with burnout and engagement: A multi-sample study. J*ournal of Organizational Behavior, 25*(3), 293-315. https://doi.org/10.1002/job.248

Schwab, K. (2015). *The Fourth Industrial Revolution: What it means, how to respond. World Economic Forum*. https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

Schwab, K. (2017). *The fourth industrial revolution*. Currency.

Sigmon, S. T., Pells, J. J., Boulard, N. E., Whitcomb-Smith, S., Edenfield, T. M., Hermann, B. A., Lamattina, S. M., Schartel, J. G., & Kubik, E. (2005). Gender differences in self-reports of depression : The response bias hypothesis revisited. *Sex Roles, 53*(5-6), 401-411. https://doi.org/10.1007/s11199-005-6762-3

Sigursteinsdottir, H., & Karlsdottir, F. B. (2022). Does social support matter in the workplace? Social support, job satisfaction, bullying and harassment in the workplace during COVID-19. *International Journal of Environmental Research and Public Health, 19*(8), 4724-4738. https://doi.org/10.3390/ijerph19084724

Sinclair, L. (2021). Beyond victimisation: Gendered legacies of mining, participation, and resistance. *The Extractive Industries and Society, 8*(3), 100870. https://doi.org/10.1016/j.exis.2021.01.005

Skirrow, R. G., Huston, D. L., Mernagh, T. P., Thorne, J. P., Dulfer, H., & Senior, A. B. (2013). *Critical commodities for a high-tech world: Australia's potential to supply global demand*. Geoscience Australia. https://d28rz98at9flks.cloudfront.net/76526/76526.pdf

Sonnentag, S., & Fritz, C. (2015). Recovery from job stress: The stressor-detachment model as an integrative framework. *Journal of Organizational Behavior, 36*(S1), S72-S103. https://doi.org/10.1002/job.1924

Sovacool, B. K. (2021). When subterranean slavery supports sustainability transitions? Power, patriarchy, and child labor in artisanal Congolese cobalt mining. *The Extractive Industries and Society, 8*(1), 271-293. https://doi.org/10.1016/j.exis.2020.11.018

Stanton, N. A. (2019). Thematic issue: Driving automation and autonomy. *Theoretical Issues in Ergonomics Science, 20*(3), 215-222. https://doi.org/10.1080/1463922X.2018.1541112

Steele, S. J., Abrahams, N., Duncan, K., Woollett, N., Hwang, B., O'Connell, L., van Cutsem, G., & Shroufi, A. (2019). The epidemiology of rape and sexual violence in the platinum mining district of Rustenburg, South Africa: Prevalence, and factors associated with sexual violence. *PLOS One, 14*(7), 15, Article e0216449. https://doi.org/10.1371/journal.pone.0216449

Taylor, S. E., & Stanton, A. L. (2007). Coping resources, coping processes, and mental health. *Annual Review of Clinical Psychology, 3*(1), 377-401. https://doi.org/10.1146/annurev.clinpsy.3.022806.091520

Thomson, J. (2018). *Business lags on riding the AI wave*. The Australian Financial Review.

Tian, F., Li, H., Tian, S., Shao, J., & Tian, C. (2022). Effect of shift work on cognitive function in Chinese coal mine workers: A resting-state fNIRS study. *International Journal of Environmental Research and Public Health, 19*(7), 4217. https://doi.org/10.3390%2Fijerph19074217

Torkington, A. M., Larkins, S., & Gupta, T. S. (2011). The psychosocial impacts of fly-in fly-out and drive-in drive-out mining on mining employees: A qualitative study. *Australian Journal of Rural Health, 19*(3), 135-141. https://doi.org/10.1111/j.1440-1584.2011.01205.x

Tuckey, M. R., Zadow, A., Li, Y., & Caponecchia, C. (2021). *Prevention of workplace bullying through work and organizational design*. In P. D'Cruz, E. Noronha, C. Caponecchia, J. Escartín, D. Salin, & M. R. Tuckey (Eds.), Dignity and inclusion at work (pp. 29-58). Springer Nature: Singapore. https://doi.org/10.1007/978-981-13-0218-3_2

Tynan, R. J., Considine, R., Rich, J. L., Skehan, J., Wiggers, J., Lewin, T. J., James, C., Inder, K., Baker, A. L., & Kay-Lambkin, F. (2016). Help-seeking for mental health problems by employees in the Australian mining industry. *BMC Health Services Research, 16*(1), Article 498. https://doi.org/10.1186/s12913-016-1755-1

Tynan, R. J., James, C., Considine, R., Skehan, J., Gullestrup, J., Lewin, T. J., Wiggers, J., & Kelly, B. J. (2018). Feasibility and acceptability of strategies to address mental health and mental ill-health in the Australian coal mining industry. *International Journal of Mental Health Systems, 12*(1), Article 66. https://doi.org/10.1186/s13033-018-0245-8

United Nations Women. (2019). *Handbook: Addressing violence and harassment against women in the world of work*. https://www.unwomen.org/sites/default/files/Headquarters/Attachments/Sections/Library/Publications/2019/Addressing-violence-and-harassment-against-women-in-the-world-of-work-en.pdf

Vanhala, M., & Ritala, P. (2016). HRM practices, impersonal trust and organizational innovativeness. *Journal of Managerial Psychology, 31*(1), 95-109. https://doi.org/10.1108/JMP-03-2013-0084

Velander, F., Schineanu, A., WenBin, L., & Richard, M. (2010). Digging for gold and coming up blue: A health survey in the mining industry. *Journal of Occupational Health and Safety-Australia and New Zealand, 26*(5), 389-401.

Vojnovic, P., & Bahn, S. (2015). Depression, anxiety and stress symptoms among fly-in fly-out Australian resource industry workers. *Journal of Health, Safety and Environment, 31*(3), 207-223.

Wall, T. D., Cordery, J. L., & Clegg, C. W. (2002). Empowerment, performance, and operational uncertainty: A theoretical integration. *Applied Psychology, 51*(1), 146-169. https://doi.org/10.1111/1464-0597.00083

Walsh, S. M., & Strano, M. S. (2018). *Robotic systems and autonomous platforms: Advances in materials and manufacturing*. Woodhead Publishing.

Wharton, A.S. (2006). *The sociology of gender: An introduction to theory and research*. Oxford: Blackwell.

World Health Organisation. (2022). *Mental health: Strengthening our response*. https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response

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Report prepared for the Western Australian Government October 2022

Worley, J. A., Bailey, L. L., Thompson, R. C., Joseph, K. M., & Williams, C. A. (1999). *Organizational communication and trust in the context of technology change*. U.S. Department of Transportation, Federal Aviation Administration. https://www.faa.gov/data_research/research/med_humanfacs/oamtechreports/1990s/media/am99-25.pdf

Yakovleva, N., Vazquez-Brust, D., Arthur-Holmes, F., & Busia, K. A. (2022). Gender equality in artisanal and small-scale mining in Ghana: Assessing progress towards SDG 5 using salience and institutional analysis and design. *Environmental Science & Policy, 136*, 92-102. https://doi.org/10.1016/j.envsci.2022.06.003

Yang, X., Zhang, B., Wang, L., Cao, L., & Tong, R. (2021). Exploring the relationships between safety compliance, safety participation and safety outcomes: Considering the moderating role of job burnout. *International Journal of Environmental Research and Public Health, 18*(8), Article 4223. https://doi.org/10.3390/ijerph18084223

Yu, M., & Li, J. (2020). Work-family conflict and mental health among Chinese underground coal miners: The moderating role of psychological capital. *Psychology, Health & Medicine, 25*(1), 1-9. https://doi.org/10.1080/13548506.2019.1595686

Yu, M., & Li, J.-Z. (2019). Influence of behavior based safety management on improving of environmentally coal miner's mental health. *Ekoloji, 28*(107), 4513-4520.

Yu, M., Qin, W., & Li, J. (2022). The influence of psychosocial safety climate on miners' safety behavior: A cross-level research. *Safety Science, 150*, Article 105719. https://doi.org/10.1016/j.ssci.2022.105719

Zhou, V. (2019). *FIFO vs residential hire: A tug of war*. Australian Mining. https://www.australianmining.com.au/features/fifo-vs-residential-hire-a-tug-of-war/

Enquiries