

Issues affecting mental health at a fly-in-fly-out mine site: A subjective impact ratings approach

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Abstract

Around a third of fly-in fly-out (FIFO) workers in Australia experience relatively high levels of psychological distress. Although a wide range of associated workplace stressors have been proposed in this context, it is unclear to what extent FIFO workers perceive these stressors as having an impact on their mental health. Identifying the issues that workers perceive as having the greatest impact on their mental health can guide the development of interventions in this area. Thus, this cross-sectional study sampled 742 FIFO workers from a large mine site in Australia to identify which workplace issues were perceived to have the greatest negative impact on their mental health. Of the 32 issues measured, we found that the top ranked issues related to a lack of control at work, lack of sleep, missing home, and poor physical health. These key issues also predicted poorer recent mental health. Based on these findings, several recommendations are put forward for future on-site wellness promotion programs, including (a) providing workers with more control and autonomy in their work roles, (b) improving sleep hygiene, (c) facilitating regular communication with family and loved ones, and (d) introducing exercise programs and supporting a healthy diet. This type of proactive consultative approach to mental health issues at FIFO sites cannot only mitigate the increased risk of poor mental health but also foster a more cohesive workplace culture.

1 | BACKGROUND

Fly-in fly-out (FIFO) work arrangements provide relatively high paying jobs in remote areas. Around 60,000 people work in FIFO resource industry positions in Australia (Education and Health Standing Committee, 2015). The geographic isolation of FIFO workplaces means that workers typically spend extended periods away from home, working long hours in mechanized high-risk environments. These difficult conditions often increase the

psychological strain of FIFO workers. For example, Vojnovic and Bahn (2015) found that around one in three Australian FIFO workers reported high-stress related symptoms, which is over double the rate in the general population. Velander et al. (2010) and Parker et al. (2018) have also reported similarly high rates of poor mental health among Australian FIFO workers. In light of this type of evidence, there is a growing concern in industry and the relevant governing bodies about the mental health of FIFO workers (e.g., Commission for Occupational Safety and Health, 2019).

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1.1 | Literature review

Although research in this area has tended to converge on the increased risk of poor mental health outcomes among FIFO workers (see Parker et al., 2018), a clear understanding of the key issues that account for this increased risk is lacking (Bowers et al., 2018). Identifying the key issues that affect FIFO workers' mental health can guide more precise health and wellness programs and initiatives. The implementation of more targeted mental health initiatives is beneficial not only for workers and their families, but also business objectives and legal obligations (Parker et al., 2018). Price Waterhouse Cooper (2014) estimated that every \$1 invested by employers to improve workers' mental health resulted in a return of \$2.30. Importantly, for the high-risk resource sector, this return was estimated to be even higher, at \$5.70.

Several studies have highlighted potential stressors associated with FIFO work arrangements in Australia. For example, a study that collected survey responses from a large sample of FIFO workers at multiple mining and construction sites found that the most frequently reported stressors were missing special events, relationship problems with partners, financial concerns, shift rosters, and social isolation (Bowers et al., 2018). Another large sample study from multiple FIFO industries (mining, oil and gas, and construction) identified lack of sleep and fatigue, bullying behavior, and issues concerning work design (e.g., job insecurity and leadership) and lifestyle as relevant factors (Parker et al., 2018). Based on the findings of their mixed method study, Parker et al. (2018) recommended that FIFO operations continue to monitor the mental health of workers and assess the psychosocial factors that affect their mental health. A proactive approach toward identifying and responding to these issues can help to prevent harm, mitigate illness, and promote wellness across the FIFO sector (Parker et al., 2018).

1.2 | The current study

Although it is reasonable to assume a degree of overlap between stressors across FIFO industries and operations, it is also likely that these issues depend on the specific operation, including its particular populations of personnel, workplace procedures, and work designs. Hence, in the current study, we focused our investigation on a population of FIFO workers at a specific operational mine site.

From a methodological standpoint, there are two potential approaches to determine the predictors of poor mental health among a population of FIFO workers. The more traditional approach is to obtain relatively objective measures of several factors (e.g., number of standard drinks per day and the number of hours sleep) and to then test the association between these factors and a validated measure of mental health (e.g., Considine et al., 2017).

The second, subjective approach is to ask FIFO workers to indicate the extent to which they believe that various factors (e.g., alcohol consumption and sleep quality) have negatively affected their mental health. Juniper et al. (2012) and Rubin (2021) have used this

second approach to investigate university students' mental health. However, this subjective impact ratings approach remains untested in the workplace. An advantage of the subjective impact ratings approach is that it allows participants' personal experiences and knowledge to inform the research results. Hence, it is a more consultative approach. From an applied perspective, population-level site-wide intervention programs that are informed by workers' own views are also more likely to be endorsed by those workers as being necessary and, therefore, to result in greater uptake (Rubin, 2021).

A further advantage of Rubin's (2021) subjective impact ratings approach is that it taps into both the *population prevalence* and *subjective impact* of issues on mental health. For example, although workers' drug use may have a relatively large negative impact on their mental health (i.e., high individual-level impact), only a relatively small proportion of workers may use drugs (i.e., low population prevalence), leading to a low mean impact rating at the population level. In contrast, an unhealthy diet may only have a medium negative impact on each worker's mental health (medium individual impact), but it may do so among a relatively high proportion of workers (high prevalence), leading to a higher mean impact rating at the population level. In this case, site-wide interventions addressing dietary choices are more likely to have a greater impact on mental health at the population level than interventions that address drug use. Hence, Rubin's (2021) subjective impact ratings approach is well-suited to inform efficient site-wide mental health intervention programs.

1.3 | Objectives

In the current study, we used Rubin's (2021) subjective impact rating approach to examine the mental health of FIFO workers at a large mining operation in Western Australia. The research had three main objectives: (a) to indicate the issues that workers perceive to have the greatest negative impact on their mental health; (b) to confirm the association between these issues and mental health using a validated measure of depression, anxiety, and stress; and (c) to provide recommendations for site-wide organizational changes that may promote better mental health across this FIFO population.

2 | METHOD

2.1 | Participants

We recruited participants using internal memos and advertising materials that were placed around the mine site. Using convenience sampling, close to half of the ~1500 workers employed at the mine site were surveyed ($N = 770$). Twenty-eight participants started the survey but did not complete it fully and so were excluded from the analysis. Hence, our final sample consisted of 742 participants.

Most participants completed the paper version during pre-shift presentations between October 21 and November 1, 2019 (93.8%, $n = 696$). The online version was open from October 20 to December 2,

2019 ($n = 46$). The median duration for the online survey was 9 min and 27 s. The completion times for the paper version was not measured.

A sensitivity analysis was conducted using G*Power 3 (Faul et al., 2007). We found that a two-sided zero-order correlation test with an α level of .05, a power level of 0.90, and a sample size of 742 could detect an effect as small as $r = 0.12$. This degree of sensitivity is suitable given that an effect size of $r = 0.19$ is typical in the field of psychology (Stanley et al., 2018).

2.2 | Measures

The 72-item survey was designed by the authors and incorporated several previously validated scales. For our subjective impact rating approach to be feasible, participants first needed to understand what we meant by “mental health.” For this reason, we began the survey with a definition of mental health: “Poor mental health includes common issues that we all face from time to time, including feelings of depression, anxiety, and stress.” We then asked participants to complete the 21-item Depression Anxiety Stress Scales (DASS-21, Henry & Crawford, 2005; Lovibond & Lovibond, 1995), and we made it clear that the DASS-21 items were measuring mental health. The intention was for participants to attain a greater understanding of what mental health entailed as they completed the DASS-21 items. This understanding was then expected to facilitate their completion of the subsequent subjective impact ratings.

The DASS-21 has been used in previous FIFO mental health research (e.g., Vojnovic & Bahn, 2015). Participants responded to each item using a 4-point scale anchored *never* (0) to *always* (3). In the current study, the total sum of the three DASS-21 subfactors was used as an overall measure of recent mental health ($\alpha = .93$; e.g., Zanon et al., 2020). The original DASS-21 assesses participants' mental health over the past week. However, due to the roster rotations on-site, a one week recall period would entail a portion of workers completing the DASS-21 after spending the last week on-site and a portion of workers completing it after spending the last week at home. Research has found that time on and off site (i.e., roster rotation) is a potentially influential factor in the mental health of FIFO workers (Rebar et al., 2018). Hence, to reduce the influence of this variable in our data, we modified the DASS-21 instructions to cover mental health over the past 2 weeks.

Participants then indicated the extent to which they believed that issues, such as drinking alcohol and a lack of training, negatively affected their mental health on-site over the last six months (e.g., Bowers et al., 2018). Following Rubin (2021), participants rated each issue on a 101-point scale anchored *low impact* (0) to *high impact* (100). Note that a low score indicated that the worker had either not experienced an issue or that they had experienced an issue but that it had not had an appreciable subjective effect on their mental health. In contrast, a high score indicated that a worker had both experienced an issue and that it had a subjectively negative impact on their mental health. The 32 impacting issues measured in the current study are listed in Table 2.

As per Rubin (2021), participants then indicated how they felt their mental health had changed over the past year. Participants responded using a 201-point scale anchored *got a lot worse* (−100) to *got a lot better* (100), with a midpoint of 0 (*stayed exactly the same*). Next, participants completed Thompson and Phua's (2012) 4-item Index of Affective Job Satisfaction (e.g., “I find real enjoyment in my job”). Participants were instructed to respond considering their work over the past six months, using a 7-point Likert type scale anchored *strongly disagree* (1) to *strongly agree* (7).

Finally, participants completed 8 items that measured work-related information, including duration of employment on-site, main employer, typical work role, department, part of the mine worked, typical roster, shift length, and shift type. Participants also completed 6 items that measured basic demographic information, including age band, gender, ethnicity, English as a first language, romantic relationship status, and any dependants less than 18 years old.

2.3 | Procedure

This study was approved by the administering university's human ethics research committee (H-2018-0331). The study was also preregistered before data collection on the Open Science Framework (https://bit.ly/FIFO_1), although we acknowledge the limitations of this approach (Rubin, 2020). The OSF link also contains an updated preregistration document (detailing the deviations from the protocol), the research materials, data set, and data aggregation code.

Participants were eligible to complete the survey if they were a company or permanent contract worker at the mine site. Note that some FIFO operations also include a portion of local residential workers who may face different challenges to those in FIFO positions (see Miller et al., 2019). However, in the present case, the mine site was over five hours drive to the nearest small town. Hence, no workers at this site returned to their place of residence after each shift.

Participants completed the survey either online or in paper format. Participants were informed that neither the researchers nor the site would attempt to identify individuals from the responses. Nonetheless, they could leave one or more items blank if they were concerned that a response may reveal their identity.

2.4 | Analytical approach

To begin our analysis, we compared the recent mental health of participants with that of the general population and other FIFO workers (i.e., scores on the DASS-21). Specifically, we used one-sample t -tests with a significance threshold of 0.05 and calculated Bayes factors with a Cauchy prior width adjusted to 0.30 (Gervais, 2015; Lee & Wagenmakers, 2014). We then tested for recent mental health differences in the current sample as a function of work characteristics (e.g., roster and shift length) using ANOVAs and t -tests with corresponding Bayes factors.

To determine which issues were perceived by workers as having the most negative impact on their mental health, mean scores were calculated and ranked in descending order. Next, to determine the relationship between the perceived issues and the DASS-21, Pearson correlation coefficients were calculated.

To address the final research objective of providing recommendations aimed at improving mental health on-site, we first reduced the original 32 issues down to the 15 issues that had the highest perceived impact on mental health.¹ Next, an exploratory factor analysis was used to identify factors among the top 15 ranked issues. A multiple linear regression analysis was then used to examine which of the factors independently predicted poor recent mental health, while controlling for the other issues.

As a supplement to the regression indices, a relative weight analysis (Johnson, 2000) was conducted using RWA-Web (Tonidandel & LeBreton, 2014). Relative weight analysis partitions the explained variance among multiple correlated predictors, producing indices that indicate the relative importance of each predictor (Johnson & LeBreton, 2004). Confidence intervals for the individual relative weights and all corresponding significance tests were based on bootstrapping with 10,000 replications and an α level of .05 (Tonidandel et al., 2009). The significant issues from the regression and relative weight analysis were the focus of our recommendations. Finally, a series of mediation analysis examined the interconnectedness of the key issues.

3 | RESULTS

3.1 | Demographic composition of the sample

Table 1 provides a breakdown of the key demographic and work-related information. Based on the 742 responses, most participants were male (88.6%, $n = 627$) and White/Caucasian ethnicity (82.1%, $n = 576$). Most participants were in a committed relationship (72.4%, $n = 537$), and just under half had dependants under 18 years of age (45.0%, $n = 334$).

In relation to work-related information, 36.1% ($n = 263$) of participants had worked on-site for less than a year, and 8.1% ($n = 59$) had worked on-site for 10 or more years. Just under a third of participants (31.2%, $n = 226$) were company employees, and the remainder (68.8%, $n = 498$) were employed by contractors, with two major on-site contractors accounting for almost half the contractor workforce. Most participants typically worked 12 h shifts (63.1%, $n = 468$), with 30.3% ($n = 225$) typically working longer than 12 h shifts. The majority of participants worked a mix of day and night shifts (57.3%, $n = 425$), with 38.8% ($n = 288$) working day shifts only. Finally, almost half of the participants worked 2 weeks on, 1 week off (47.1%, $n = 338$), and 39.7% ($n = 285$) worked 8 days on, 6 days off.

3.2 | Recent mental health

In terms of comparing FIFO populations, we found very strong evidence, $t(741) = -3.79$, $p \leq .001$, $BF_{10} = 99.60$, that participants in

TABLE 1 Demographic and work-related information

Variable	N	Percentage
<i>Gender</i>		
Men	627	88.6%
Women	80	11.3%
Other	1	0.1%
<i>Age band (years)</i>		
18–29	138	19.6%
30–39	207	29.4%
40–49	185	26.3%
50–59	137	19.5%
Over 60	37	5.3%
<i>Ethnicity</i>		
White	576	82.1%
Aboriginal	26	3.7%
Torres Strait Islander	1	0.1%
Asian	30	4.3%
African	13	1.9%
Indian	3	0.4%
Other	53	7.5%
<i>Employment type</i>		
Company worker	226	31.2%
Contract worker	498	68.8%
<i>Time at mine</i>		
Less than a year	263	36.1%
1–2 years	194	26.6%
3–5 years	123	16.9%
5–10 years	90	12.3%
10 years or more	59	8.1%
<i>Work role</i>		
Operator	244	35.0%
Technical professional	58	8.3%
Tradesperson	193	27.7%
Supervisor	51	7.3%
Superintendent/manager	26	3.7%
Office-based	34	4.9%
Services	24	3.4%
Other	68	9.7%
<i>Roster</i>		
8 days on/6 days off	285	39.7%
2 weeks on/1 week off	338	47.1%
Other	94	13.2%

Note: Due to missing data the sample size varied between $n = 698$ and $n = 729$ participants for each variable.

the current study tended to report fewer mental health problems ($M = 11.92$, $SD = 8.75$) compared with another sample of FIFO workers ($N = 629$) from the resource and construction industries in Western Australia ($M = 13.14$; Vojnovic & Bahn, 2015). However, we also found very strong evidence, $t(741) = 11.27$, $p \leq .001$, $BF_{10} > 1000$, that participants tended to report poorer recent mental health compared to a broadly representative sample ($N = 497$) of Australian adults ($M = 8.30$, $SD = 9.83$; Crawford et al., 2011).

Participants' recent mental health did not differ between site employers, departments, work roles, part of the mine worked, or the amount of time working on-site ($1.21 \geq BF_{01} \leq 160.50$). There was also no difference in mental health across any of the demographic variables (e.g., gender, ethnicity, age, relationship status, and dependants ($1.12 \geq BF_{01} \leq 167.55$)). However, participants working the 2 weeks on, 1 week off roster tended to report poorer recent mental health ($M = 12.93$, $SD = 9.10$, $n = 338$) than participants who worked 8 days on, 6 days off ($M = 10.89$, $SD = 8.07$, $n = 285$), $t(619) = -2.97$, $p = .003$, $BF_{10} = 9.76$. Furthermore, participants who typically worked more than 12 h shifts tended to report poorer recent mental health ($M = 12.81$, $SD = 8.89$, $n = 225$) than participants who worked 12 h shifts ($M = 11.43$, $SD = 8.57$, $n = 468$), $t(691) = -1.97$, $p = .049$, $BF_{10} = 1.15$. Please see the updated preregistration document for further information on these comparisons.

3.3 | Subjective impacting issues

Table 2 presents the mean scores for the subjective impacting issues, with issues ranked in descending order of impact. Table 2 also shows that all 32 issues were positively correlated with poorer mental health ($0.19 \geq r_s \leq 0.54$). These correlations provide some convergent validity between the two measures (i.e., impacting issues and DASS-21). On average, participants rated missing home, a lack of sleep, and feeling underpaid as having the highest impact on their mental health. According to the scale anchors, these three top issues had "a medium impact" on mental health. Conversely, issues related to prejudice, discrimination, being bullied, and drug use had the lowest impact ratings.

We performed an exploratory principal axis factor analysis on the top 15 ranked issues. In this analysis, the Kaiser–Meyer–Olkin measure of sampling adequacy was substantially higher than 0.50 (0.89), and Bartlett's test of sphericity was statistically significant ($\chi^2 = 3320$, $df = 105$, $p \leq .001$). Hence, the data were appropriate for analysis.

Three factors had eigenvalues greater than 1.0, and a scree plot suggested the extraction of two factors. To provide a clearer assessment, we conducted a parallel analysis using Watkins' (2000) Monte Carlo simulation with 1000 random data sets, each containing 15 variables and 742 participants. The first three factors in the real data set had eigenvalues that were larger than the simulated data sets (simulated eigenvalues: 1.25, 1.19, and 1.15). Hence, we specified the extraction of three factors. We used the promax method of oblique rotation during factor extraction ($\kappa = 3$) to allow the factors to correlate with one another (Clark & Watson, 2019). Table 3 shows the pattern matrix factor loadings of the three extracted factors.

TABLE 2 Ranked list of impacting issues and correlation coefficients with recent mental health

Impacting issue	M	SD	r
Missing family/partner/friends	45.89	29.33	0.40
Lack of sleep (quality and duration)	45.22	26.38	0.46
Feeling underpaid	44.04	29.74	0.28
Homesickness	41.04	28.73	0.41
Poor on-site facilities	41.03	29.36	0.27
Physical work environment	37.92	27.12	0.33
Lack of career progression	37.16	29.57	0.40
Lack of trust in management	35.92	28.37	0.40
Lack of physical exercise	35.17	24.37	0.32
Lack of control at work	34.49	25.68	0.44
Boredom	34.34	24.08	0.40
FIFO lifestyle	32.40	26.42	0.41
Productivity time pressure	31.64	25.50	0.40
Organizational changes	31.40	23.67	0.44
Unhealthy diet	31.10	23.89	0.31
Loneliness	31.02	26.93	0.52
Unfair procedures or decisions	30.80	25.08	0.30
Lack of training	30.80	26.71	0.31
Traveling between home and site	30.75	27.71	0.38
Length of work roster	30.39	28.88	0.33
Site rules/regulations/paperwork	30.02	24.02	0.34
My physical health	29.39	23.15	0.37
Concern of losing job	28.32	26.94	0.36
Length of shifts	27.93	25.06	0.39
My coworkers	27.93	23.38	0.34
My supervisor	27.72	26.23	0.30
Sense of belonging on-site	27.67	24.29	0.54
No one to talk to about my problems	26.66	24.64	0.44
Alcohol use	18.19	19.51	0.28
Prejudice or discrimination against me	16.22	19.72	0.31
Being bullied	16.01	19.27	0.27
Drug use	10.43	14.41	0.19

Note: Due to missing data the sample size varied between $n = 456$ (drug use) and $n = 739$ for each variable. Participants were asked to rate the perceived negative impact of each issue on their mental health over the last 6 months, using a 101-point sliding bar scale anchored *low impact* (0), *medium impact* (50), *high impact* (100). The Pearson correlation coefficients were conducted on each issue and recent poor mental health (DASS-21), all $p_s \leq .01$.

As can be seen in Table 3, the first factor was labeled *lack of control issues* (6 items, $\alpha = .80$). These items relate to a lack of control while on-site, such as dealing with management, organizational changes, the order and pace of work, productivity time pressure, lack of career

TABLE 3 Factor loadings of the top 15 ranked impacting issues on mental health items

Impacting issue item	Factor 1	Factor 2	Factor 3
Eigenvalue	5.68	1.32	1.25
Percentage of variance	37.84	8.79	8.35
<i>Lack of control issues</i>			
Lack of trust in management	0.75	-0.07	<0.01
Control of work	0.64	0.04	0.03
Productivity time pressure	0.62	0.19	-0.14
Lack of career progression	0.57	-0.02	0.10
Feeling underpaid	0.53	0.03	0.01
Organizational changes	0.52	-0.02	0.10
Physical work environment	0.38	0.29	-0.01
Poor on-site facilities	0.35	0.08	0.16
<i>Missing home issues</i>			
Missing family/partner/friends	0.03	0.85	-0.06
Homesickness	-0.05	0.84	0.07
FIFO lifestyle	0.08	0.65	0.06
<i>Physical health issues</i>			
Lack of physical exercise	-0.08	0.02	0.71
Unhealthy diet	0.05	0.00	0.68
Boredom	0.22	0.01	0.46
Lack of sleep (quality and duration)	0.28	0.20	0.30

Note: Values in bold are above the cut-point criteria of ≥ 0.50 factor loadings and $\leq |0.20|$ cross-loadings on the other factors. Missing data deleted listwise.

Abbreviation: FIFO, fly-in fly-out.

progression, and feeling underpaid. The second factor was labeled *missing home issues* (3 items, $\alpha = .84$). These items reflect the remoteness of FIFO work and the regular separation from home, including issues such as the FIFO lifestyle, homesickness, and missing family, friends and loved ones. Finally, the third factor was labeled *physical health issues* (2 items, $\rho = 0.68$). These items relate to diet and exercise. In summary, the top 15 subjective impacting issues were reduced to three factors and four single-item issues (i.e., the physical work environment, poor on-site facilities, boredom, and a lack of sleep).

3.4 | Descriptive statistics

Table 4 provides the means, standard deviations, and Pearson zero-order correlation coefficients for the key continuous variables, including the DASS-21 and revised top impacting issues (based on the exploratory factor analysis). Looking at Table 4, all three of the impacting issue factors were positively associated with recent poor mental health ($0.33 \geq r_s \leq 0.48$). Participants typically reported that

their mental health had declined slightly in the last year ($M = -2.71$, $SD = 40.03$). However, this score did not significantly differ from the scale's zero midpoint of no change in mental health, $t(678) = -1.77$, $p = .078$, $BF_{01} = 2.22$. On average, participants tended to "partially agree" that they found satisfaction in their work over the last 6 months ($M = 4.95$, $SD = 1.29$). As expected, job satisfaction was negatively associated with poorer recent mental health ($r = -0.39$).

3.5 | Subjective impacting issues that predict recent mental health

A multiple regression analysis was used to determine which of the top subjective impacting issues independently predicted poor mental health. As a supplement to the regression indices, a relative weight analysis was also conducted. As can be seen from Table 5, the relative weight results replicated the pattern of results from the multiple regression analysis ($F = 48.03$, $p \leq .001$).

The regression and relative weight indices showed that four variables explained a statistically significant amount of variance in recent mental health. The results indicate that a weighted linear combination of the four impacting issues explained roughly a third of the variance in recent mental health ($R^2 = 0.33$). The majority of the explained variance in poor mental health was attributed to the perceived lack of control issues (28.3% of model R^2), followed by a perceived lack of sleep (24.9% of model R^2), missing home issues (20.0% of model R^2), and physical health issues (10.6% of model R^2). There were no differences in the magnitude of the relative weights as a function of employment type (*company vs. contract workers*).

A series of mediation analysis showed the interconnectedness of the four key issues (Supporting Information: Table 6). For example, a lack of control, missing home, and physical health issues independently explained the relationship between the perceived impact of a lack of sleep and poor recent mental health. In addition, a lack of sleep explained the relationships between (a) lack of control, (b) missing home, and (c) poor physical health with recent poor mental health.

Finally, given the negative association between job satisfaction and recent mental health, we also reran the regression analysis with job satisfaction as the criterion ($F = 33.53$, $p < .001$, $R^2 = 0.25$). The results of this analysis indicated that boredom (31.3% of model R^2), lack of control (21.0% of model R^2), missing home (18.1% of model R^2), and the physical work environment (10.2% of model R^2) predicted job satisfaction (Supporting Information: Table 7).

3.6 | Robustness analyses

We reran the key analyses detailed in this paper with and without outliers. Outliers were defined as cases that were ± 3 SDs from the sample mean. A total of 10 outliers were identified for the measure of recent mental health, six for the physical health factor, and one for the lack of control factor. No substantial differences were detected in the reported results.

TABLE 4 Descriptive statistics and zero order correlation coefficients

Measure	M	SD	1	2	3	4	5	6	7	8	9
DASS-21 total	11.92	8.75	-								
Mental health change	-2.71	40.03	-0.38**	-							
Job satisfaction	4.95	1.29	-0.39**	0.30**	-						
Lack of control issues	35.74	19.39	0.48**	-0.31**	-0.41**	-					
Missing home issues	39.73	24.69	0.43**	-0.33**	-0.37**	0.48**	-				
Physical health issues	33.19	21.45	0.33**	-0.16**	-0.26**	0.39**	0.35**	-			
Lack of sleep	45.22	26.38	0.45**	-0.27**	-0.30**	0.47**	0.47**	0.41**	-		
Poor on-site facilities	41.03	29.36	0.24**	-0.16**	-0.26**	0.43**	0.34**	0.28**	0.48**	-	
Work environment	37.92	27.12	0.29**	-0.13**	-0.32**	0.46**	0.46**	0.27**	0.39**	0.39**	-
Boredom	34.34	24.08	0.30**	-0.16**	-0.42**	0.43**	0.36**	0.44**	0.37**	0.32**	0.28**

Note: $N = 647$ (missing values deleted listwise). Higher scores indicate poorer mental health in the last 2 weeks (scale total score range 0–63). Hence, mental health was considered on a continuous scale rather than vis-à-vis cut-off scores. Measures 4–10 are the subjective impacting issues that used a 101-point sliding bar scale anchored *low impact* (0) to *high impact* (100). Measures 4, 5, and 6 are the three impacting issue factors based on the exploratory factor analysis (Table 3).

Abbreviation: DASS-21, Depression, Anxiety, Stress Scale.

** $p < .01$.

TABLE 5 Regression testing predictors of recent mental health

Impacting issue	β	t	p	RW	Lower CI	Upper CI	RS-RW
Lack of control issues	.27	6.63	<.001	0.09	0.06	0.13	28.29
Missing home issues	.17	4.31	<.001	0.06	0.04	0.09	20.00
Physical health issues	.08	2.12	.035	0.03	0.01	0.06	10.62
Lack of sleep (quality & duration)	.24	5.87	<.001	0.08	0.05	0.11	24.90
Poor on-site facilities	-.06	-1.62	.106	0.01	0.00	0.02	3.50
Physical work environment	<.01	-0.12	.908	0.02	0.00	0.04	6.07
Boredom	.02	0.66	.512	0.02	0.00	0.04	6.62

Note: The outcome was the DASS-21. The predictor variables included the subjective impacting issues scored on a 101-point sliding bar scale anchored *low impact* (0) to *high impact* (100). Enter regression method was used with missing data deleted listwise. Beta values are standardized. Significant effects are indicated in bold ($ps \leq .035$ or the RW CIs do not contain zero).

Abbreviations: CIs, 95% lower and upper confidence interval bounds to test the significance of the relative weights; DASS-21, 21-item Depression Anxiety Stress Scales; RS-RW, relative weight rescaled as a percentage of predicted variance in the criterion variable attributed to each predictor; RW, raw relative weight.

4 | DISCUSSION

Around a third of Australian FIFO workers experience relatively high psychological distress (Vojnovic & Bahn, 2015), and this issue is a growing concern for the industry (Commission for Occupational Safety and Health, 2019). Although research has identified several broad stressors that are common across FIFO industries and operations (e.g., Parker et al., 2018), it is reasonable to assume that these stressors may be more or less relevant depending on the specific operation. Hence, identifying the key issues at *particular* FIFO operations can guide more precise sitewide wellness programs. In the current study, we used a subjective impact ratings approach

(Rubin, 2021) to identify the key work-related issues that negatively impacted the mental health of a sample of FIFO workers at a large mine site in Australia.

We found that workers at this operation typically reported better recent mental health than a comparable sample of FIFO workers in a previous study (Vojnovic & Bahn, 2015). However, they also had poorer mental health than that of the general Australian population (Crawford et al., 2011), which is consistent with previous research in this area (e.g., Asare et al., 2021; Parker et al., 2018). This body of research suggests that the FIFO lifestyle (including the separation from family for extended periods), organizational and worksite factors (e.g., site rules and procedures), and demographic

characteristics (e.g., age and education) may all contribute to poorer mental health among FIFO workers (Parker et al., 2018; Vojnovic & Bahn, 2015).

In terms of differences within the sample, we found that participants working 2 weeks on, 1 week off tended to report poorer mental health than participants working 8 days on, 6 days off. In addition, participants who typically worked more than 12 h shifts tended to report poorer mental health than those on 12 h shifts. Hence, broader job factors like roster and shift rotations are contributing factors to FIFO workers mental health, which is consistent with previous research in this area (Parker et al., 2018). However, it is worth noting that the current study did not detect mental health differences between broader demographic characteristics such as age and gender.

The results of the subjective impact ratings approach highlighted (a) the top ranked issues perceived by FIFO workers as negatively impacting their mental health, (b) which of the top ranked issues independently explained poor mental health, and (c) the interconnectedness of the four key issues that explained poor mental health. In terms of the top ranked issues, an exploratory factor analysis revealed three factors and four unique single-item issues. The factors included issues related to a lack of control (6 items), missing home (3 items), and physical health (2 items). The remaining single-item issues included a lack of sleep, boredom, the physical work environment, and poor on-site facilities.

While each of the top ranked issues were associated with poor mental health, regression, and relative weight analyses revealed that four issues accounted for around a third of the variance in workers' mental health. Of these, issues related to a lack of control accounted for the most variance, followed by a lack of sleep, missing home, and physical health. A series of mediation analyses also revealed the interconnectedness of these four key issues. For example, the relationship between a lack of sleep and poor mental health was independently explained by the impact of missing home, a lack of control at work, and physical health issues.

Taken together, these results suggest that high production pressures under conditions of low control/autonomy over decision making and job tasks (i.e., a lack of control) has a negative impact on FIFO workers' mental health. Moreover, working under these conditions for long hours over consecutive days likely leads to mental exhaustion and fatigue (i.e., a lack of sleep), which also negatively impacts workers' mental health. The lack of sleep and cycle of transitioning from work to home life is a further issue impacting FIFO workers' mental and physical health. On top of these work-related issues, FIFO workers must contend with the isolation while on rotation, being separated from family and friends and missing out on important social events.

4.1 | Recommendations

The recommendations provided below are based on (a) the results of the subjective impact ratings approach, (b) consultation with key

company personnel at the mine site in question, and (c) previous research in this area. To begin, it is worth noting which issues were perceived as having the *lowest* impact on mental health and the *smallest* association with recent mental health.

In the current study, the perceived impact of drug use was ranked lowest on these two criteria. Given the strict company rules on illegal drug use, it is reasonable to assume that most workers do not engage in drug use behavior on-site. However, these rules are also likely to lead to drug use being underreported in our survey due to workers' concerns about privacy and confidentiality. In addition, although issues like bullying have been identified in previous FIFO research as a risk factor to mental health (e.g., Parker et al., 2018), these issues also ranked low on the two criteria in the current study (e.g., bullying, prejudice or discrimination, my supervisor, and co-worker issues). Thus, issues concerning drug use and workplace relationships, although associated with mental health, were (a) not prevalent or (b) prevalent but not impactful in this sample. Therefore, site wide interventions based on these issues may face an uphill struggle vis-à-vis employee engagement and uptake, because most workers do not view these issues as being impactful on their mental health (Rubin, 2021).

In reference to the top impacting issues in this study, a perceived lack of control is consistent with previous research that has identified low autonomy and control as being related to poor mental health (e.g., Commission for Occupational Safety and Health, 2019; Safe Work Australia, 2014). The necessarily strict rules and work procedures that are required in remote, high-risk mining operations make these issues difficult to mitigate directly. Therefore, we recommend that leadership teams consider implementing strategies to lessen the impact of work design on mental health (see also Parker et al., 2018). Specifically, strategies aimed at building relationships with work teams, routinely discussing work goals and responsibilities, increasing consultancy and transparency, and monitoring without micromanaging. Team leaders that can foster greater worker participation in decision making, while adhering to the necessary safe work procedures, may enhance workers' sense of autonomy and control, job satisfaction, and mental health (Parker, 2014; Tuck et al., 2013; Wu et al., 2015).

Consistent with our finding regarding lack of sleep, a review of over 50 studies that included FIFO workers found fatigue and sleep to be common problems (Parker et al., 2018). Based on this line of research, we recommend sleep hygiene education to support healthy sleep habits and fatigue management of workers (Parker et al., 2018; Pilcher & Morris, 2020). For example, sleep hygiene programs may cover (a) the role and importance of sleep (e.g., recover and restore), (b) the consequences of fatigue (e.g., decreased attention, and compromised decision making), and (c) specific strategies for FIFO workers to improve sleep quality and duration (e.g., winding down, routine, lifestyle, and sleep environment). In addition, assessing the feasibility of room soundproofing and new bedding may also help workers with this central issue. Concerning work design, consultation on the viability of even time or shorter roster rotations as well as ensuring adequate rest periods for workers who are required to work

more than 12 h shifts may also improve sleep and the mental health of workers (Parker et al., 2018).

The perceived impact of issues relating to missing home is also consistent with previous research that has identified this issue as being related to poor mental health among FIFO workers (e.g., Bowers et al., 2018; Gardner et al., 2018). A potential initiative in this respect would be the development of a program that supports FIFO workers and their partners and families to better cope with this issue (Parker et al., 2018). Such programs may include the provision of information relating to (a) well-documented FIFO lifestyle stressors (e.g., relationship strain and isolation) and (b) specific strategies to mitigate these stressors (e.g., adjusting from site to home, support networks, and plans after FIFO work). This information could be presented in a documentary-style video format and made available to family and workers. In addition, given the limited mobile phone connectivity on-site, it may be helpful to provide a shared space with multiple computers, reliable internet/LAN connectivity, and access to video calling software (e.g., Skype and Zoom). Providing more options to talk with family while on rotation may enable workers and families to feel more connected (Parker et al., 2018). It may also assist with other issues that were raised in our survey, including on-site facilities, boredom, loneliness, and having no one to talk to on-site.

Finally, perceived physical health issues related to unhealthy diet and exercise. Group fitness activities may be effective in this respect, together with a diverse range of healthy food options with access to nutritional information (Parker et al., 2018). However, it is worth noting that the operation has recently made investment in this area.

In summary, given the interconnectedness of the identified key issues, interventions aimed at increasing workers' sense of control, facilitating regular communication with family while on-site, and promoting healthy lifestyle habits may improve workers' sleep quality and overall mental health (Åkerstedt et al., 2012; Linton et al., 2015). Although previous research has identified a broad range of work-related stressors across FIFO operations and industries (e.g., Bowers et al., 2018; Parker et al., 2018), this is the first study to use a subjective impact ratings approach to guide more precise future site-wide wellness programs among a specific FIFO mining population.

4.2 | Limitations and future research

The present research has several limitations. First, the masculine work environment at FIFO mine sites may bias workers in under-reporting mental health issues (Addis & Mahalik, 2003). For this reason, the survey was available online to be completed in more private settings. However, the majority of workers completed the survey on-site at pre-shift meetings. Second, the subjective impact approach may not detect objective causes of poor mental health. Nonetheless, it is reasonable to assume that workers are aware of many of the issues that cause them stress on-site. Third, and as discussed previously, the measurement of impacting issues confounded the frequency with which workers experienced the issues with the perceived impact of those issues on their mental health.

Nonetheless, interventions that focus on issues raised by this subjective impact approach are more likely to experience greater uptake by the workforce because these issues are more prevalent and the workforce regards them as being more relevant to their circumstances (e.g., Cox et al., 2007; Rubin, 2021). Fourth, the findings of the current research are likely to be site-specific, and they may not generalize to other FIFO sites or industries.

It is also important to note that the cross-sectional correlational design that was used in this research does not allow clear conclusions to be reached regarding the causal direction of the proposed processes. For example, we assumed that a lack of sleep leads to poorer mental health, and there is some prior evidence to support this view (e.g., Breslau et al., 1996). Nonetheless, we cannot rule out the possibility that poorer mental health leads to a higher perceived negative impact of a lack of sleep (e.g., Jansson-Fröjmark & Lindblom, 2008). From a causal perspective, the next step in this area is to test the efficacy of site-wide wellness programs and initiatives using an experimental and/or longitudinal approach.

5 | CONCLUSION

In summary, the current research used a subjective impact rating approach to identify four key interconnected issues that FIFO workers perceived as negatively impacting their mental health while on-site: a lack of control at work, lack of sleep, missing home, and poor physical health. These key issues also each predicted workers' recent poor mental health. Based on these results, future health and wellness strategies at this FIFO mine site should consider (a) providing workers with more control and autonomy in their work roles, (b) improving sleep hygiene, (c) facilitating regular communication with family and loved ones, and (d) introducing exercise programs and supporting a healthy diet. A proactive consultative approach to mental health issues at FIFO sites can not only mitigate the increased risk of poor mental health but also cultivate a supportive workplace culture, with higher worker productivity and job satisfaction.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The preregistered research protocol, research materials, data set, data aggregation code, updated preregistration document, and supplementary file associated with the current study are available in the Open Science Framework repository at https://bit.ly/FIFO_1.

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ENDNOTE

¹ Note that Rubin (2021) first calculated the mean and standard deviation for all 32 issues and then deemed the six issues that were one SD above the mean as priority for future recommendations. This approach was not used in the current study as none of the 32 issues met this criterion. Instead, the current study first divided the 32 ranked issues in half, with the lowest ranked 16 issues omitted. However, due to the 16th ranked issue (loneliness) having the strongest correlation with the DASS-21 ($r=0.52$) this issue was also excluded from the subsequent analyses.

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SUPPORTING INFORMATION

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