

Work-related quality of life and its predictors among mining industry workers: a cross-sectional study

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Abstract

Purpose: This study aimed to examine the associations between Work-Related Quality of Life (WRQoL) domains and overall Quality of Work Life (QoWL) among mining employees and to assess the relative contribution of each domain to QoWL. **Methods:** A cross-sectional study was conducted among 187 Dump Truck (DT) operators in a coal mining site in East Kalimantan, Indonesia. Data were collected using the standardized WRQoL instrument. QoWL was analyzed as a continuous variable. Bivariate analysis was performed using Pearson correlation, and multivariate analysis was conducted using multiple linear regression to examine the associations between WRQoL domains and QoWL. **Results:** Five WRQoL domains, consisting of general well-being, home-work interface, job and career satisfaction, control at work, and working conditions, were significantly associated with overall QoWL (all $p < 0.001$). Stress at work was not significantly associated with QoWL ($p = 0.345$). In the multivariate model ($R^2 = 0.727$), all five domains remained significantly associated with QoWL, with control at work ($\beta = 4.085$), job and career satisfaction ($\beta = 3.917$), and home-work interface ($\beta = 3.848$) demonstrating the strongest relative contributions. **Conclusion:** QoWL among mining employees is shaped by both structural and psychosocial factors, with work-life balance, autonomy, and career satisfaction playing key roles. These findings highlight the importance of organizational strategies that enhance working conditions, support work-life integration, and promote career development to improve workforce well-being in high-risk industries.

Keywords: job satisfaction; mining; occupational health; quality of work life; working conditions

INTRODUCTION

Sustainable development places human well-being at the center of the development process, as reflected in the Sustainable Development Goals (SDGs). In the context of employment, worker well-being is an important indicator in assessing the quality of inclusive and sustainable development. Worker well-being is closely related to productivity, organizational culture, and socio-economic stability [1]. Therefore, improving

general well-being not only impacts individuals but also the sustainability of organizations and society at large.

Quality of Work Life (QoWL) has emerged as a strategic indicator of workforce sustainability in contemporary occupational health research. Increasingly, organizations recognize that employee well-being is not merely a moral imperative but a determinant of productivity, retention, and long-term institutional resilience. Recent empirical evidence

demonstrates that QoWL encompasses multidimensional constructs including psychological well-being, work-life integration, job control, career development, and working conditions [2]. Poor QoWL has been associated with emotional exhaustion, reduced engagement, and impaired organizational performance [3]. From a psychological perspective, trust, care, respect, learning, and contribution are indicators of QoWL [4].

The Work-Related Quality of Life (WRQoL) framework provides a robust multidimensional model for assessing employees' perceptions of their working life. The framework integrates six interrelated dimensions: general well-being, job satisfaction, control at work, stress at work, working conditions, and home-work interface. Importantly, these domains capture both psychosocial determinants and structural workplace factors, allowing for a comprehensive evaluation of occupational well-being [2].

From a theoretical perspective, work-family conflict remains one of the most influential explanations for variations in QoWL. Empirical findings show that work-family conflict significantly reduces QoWL, particularly when organizational support systems are inadequate [5]. Moreover, working conditions and psychosocial resources are consistently associated with professional quality-of-life outcomes [3]. These findings align with global occupational health principles promoted by the World Health Organization, which emphasize healthy workplaces as a prerequisite for protecting workers' physical and mental well-being. They also resonate with the International Labor Organization's decent work agenda, which underpins SDG 8, Decent Work and Economic Growth, by advocating for safe, equitable, and productive employment conditions. Simultaneously, SDG 3, good health and well-being, underscores the need to safeguard mental and physical health in occupational settings.

In high-risk industries such as mining, workers are exposed to hazardous environments, long working hours, shift systems, production pressures, and remote work locations [6]. In East Kalimantan, Indonesia, one of the country's major coal-producing regions, coal-getting operators, particularly Dump Truck (DT) operators, perform critical hauling tasks under demanding physical and cognitive conditions. Prolonged sitting, exposure to vibration and noise, strict productivity targets, and rotational shifts that limit family interaction may exacerbate stress, fatigue, and work-home imbalance. Such occupational characteristics create a complex interaction between psychosocial strain and structural workplace conditions, making this population a particularly relevant group for investigating WRQoL.

DT operators were deliberately selected as the study population due to their distinctive, high-risk occupational profile in the mining sector. Their work involves prolonged sedentary exposure, continuous whole-body vibration, strict productivity demands, and rotating shift systems that disrupt circadian rhythms and limit social interaction, making them particularly vulnerable to fatigue, stress, and work-home imbalance. In addition, their critical role in maintaining hauling productivity means that any decline in well-being may directly affect operational performance. Despite these risks, DT operators remain underrepresented in QoWL and WRQoL research, particularly in developing-country contexts. Therefore, this study provides a novel contribution by applying a multidimensional WRQoL framework to a specific high-risk occupational group in Indonesian coal mining. While previous studies have provided foundational insights, this study contributes by identifying specific predictors using a more granular multivariate analysis.

METHODS

Study design and setting

This study employed a quantitative cross-sectional design to examine the associations between WRQoL domains and overall QoWL among mining workers. Data were collected simultaneously from June to August 2025 at a coal mining site in East Kalimantan, Indonesia.

The study population consisted of coal-getting operators, specifically DT operators, working at the mining site. A total of 187 respondents were included in the study, selected through total sampling. The sample size was determined based on the total number of eligible DT operators available at the study site during the data collection period, and all accessible workers who met the inclusion criteria were invited to participate. Thus, the study reflects a census of available eligible operators rather than a sample derived from a formal sample size calculation. Eligible participants were active DT operators with at least 6 months of work experience. Workers who were on leave or unavailable during the data collection period were excluded.

Data collection

The dependent variable was overall QoWL, measured using the standardized (WRQoL Scale and treated as a continuous variable. The total score was calculated by summing all domain scores, representing an overall measure of work-related quality of life. It is acknowledged that the overall QoWL score is derived

from the same domains included as independent variables. Therefore, the analysis does not aim to establish causal or independent predictive relationships, but rather to examine the relative strength of association between each WRQoL domain and the overall QoWL construct.

The WRQoL instrument consists of 24 items representing six domains: general well-being (GWB), home-work interface (HWI), job and career satisfaction (JCS), control at work (CAW), working conditions (WCS), and stress at work (SAW). Each item is rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Negatively worded items were reverse-coded before analysis to ensure that higher scores consistently reflected better quality of working life. Domain scores were calculated by summing item scores within each respective domain, following the standard WRQoL scoring procedure. The overall QoWL score was obtained by summing the six domain scores, while item 24 was treated as a global indicator.

For analytical purposes, both the overall QoWL score and each WRQoL domain score were categorized into three levels (low, moderate, and high) based on the study sample's tertile distribution. This approach was used due to the absence of universally established cut-off values for this population and to allow meaningful interpretation of score distribution within the study context. Before analysis, the psychometric properties of the instrument were assessed in this study population. Construct validity testing indicated that the items demonstrated acceptable item-total correlations overall, supporting the use of the full WRQoL scale. Reliability analysis showed a Cronbach's alpha of 0.908, indicating excellent internal consistency.

The independent variables in this study were the six WRQoL domains, which were analyzed as categorical variables (low, moderate, high). Socio-demographic characteristics were also categorized, including age group (Young Adults: 20–29 years; Adults: 30–59 years) and marital status (unmarried, married, widowed).

Data were collected using a structured self-administered questionnaire that included the WRQoL Scale and socio-demographic questions. Before participation, respondents received a brief explanation of the study objectives and instructions for completing the questionnaire. To ensure consistency and authenticity of responses, participants completed the questionnaire individually without discussion, and anonymity was maintained to minimize social desirability bias. The questionnaire required approximately 10–15 minutes to complete.

Data collection was conducted during scheduled work periods in coordination with site management,

ensuring that workers from different shift schedules were proportionally represented. Completed questionnaires were reviewed for completeness at the time of submission. Responses with substantial missing data were excluded from the analysis, while minor missing values were handled using listwise deletion to maintain data integrity.

Data analysis

Data processing and analysis were conducted using STATA software. Univariate analysis was performed to summarize respondent characteristics and the distribution of study variables. Bivariate analysis was conducted using Pearson correlation to assess the relationship between each WRQoL domain and overall QoWL. Variables with statistically significant associations ($p < 0.05$) were included in the multivariate analysis. Multivariate analysis was performed using multiple linear regression to examine the relative contribution of each WRQoL domain to the overall QoWL score. Given the conceptual interrelatedness among the domains and the total score, the regression results were interpreted as indicating mathematical and structural associations within the WRQoL framework, rather than as independent causal effects.

Given that the WRQoL domains are conceptually related, potential multicollinearity was assessed by examining intercorrelations among independent variables. Although several domains showed moderate to strong correlations, no evidence of extreme multicollinearity was observed, and all variables were retained in the model based on theoretical relevance. This approach ensures that the model estimates remain interpretable while preserving the multidimensional structure of the WRQoL framework. Model fit was evaluated using the F-test, coefficient of determination (R^2), and adjusted R^2 .

RESULTS

General description

This study was conducted among coal-getting operators (DT operators) working at a coal mining site in East Kalimantan, Indonesia, a region characterized by intensive mining activities and high occupational demands. DT operators are responsible for hauling overburden and coal materials within the mining area, operating under rotational shift systems and strict production targets. Their work involves prolonged sitting, continuous vigilance, exposure to vibration and noise, and strict adherence to operational safety procedures. These characteristics place DT operators in a high-risk occupational environment where both

physical strain and psychosocial stressors may influence work-related well-being.

Data were collected between June and August 2025 from 187 active DT operators who met the inclusion criteria. Participants completed a structured questionnaire consisting of socio-demographic items and the standardized WRQoL Scale. Data collection was conducted during operational periods without disrupting routine work activities. All completed questionnaires were reviewed for completeness before data entry and statistical processing. The results are presented in three stages of analysis. First, univariate analysis describes the distribution of respondent characteristics and WRQoL domains. Second, bivariate analysis examines the associations between each WRQoL domain and overall QoWL using Pearson correlation. Third, multivariate analysis using multiple linear regression evaluates the relative contribution of each WRQoL domain to overall QoWL.

Table 1. Frequency distribution of participants and work-related quality of Life (WRQoL) domains (n=187)

Variable	Percentage (%)
Age group	
Young Adults (20-29 years)	19.79
Adults (30-59 years)	80.21
Marital status	
Unmarried	11.23
Married	83.42
Widowed	5.35
General well-being	
Low	56.15
Moderate	11.23
High	32.62
Home-work interface	
Low	15.51
Moderate	15.51
High	68.98
Job and career satisfaction	
Low	12.83
Moderate	50.27
High	36.90
Control at work	
Low	11.23
Moderate	21.39
High	67.38
Working conditions	
Low	51.87
Moderate	29.95
High	18.18
Stress at work	
Low	50.27
Moderate	21.93
High	27.81

A total of 187 respondents were included in the analysis. Most participants were adults aged 30–59 years (80.21%), while 19.79% were young adults aged 20–29 years. The majority of respondents were married (83.42%), whereas 11.23% were unmarried and 5.35% were widowed or divorced (Table 1). The distribution of WRQoL domains is presented in Table 2. More than half of respondents reported low levels of general

Table 2. Bivariate correlation between WRQoL domains and overall QoWL

WRQoL Domain	r	p-value
General well-being	0.441	<0.001
Home-work interface	0.663	<0.001
Job and career satisfaction	0.456	<0.001
Control at work	0.660	<0.001
Working conditions	0.556	<0.001
Stress at work	0.070	0.345

Table 3. Multivariable linear regression analysis of factors associated with overall QoWL

WRQoL Domain	β	95% CI	p-value
General well-being	1.564	0.662 – 2.465	<0.001
Home-work interface	3.848	2.561 – 5.135	<0.001
Job and career Satisfaction	3.917	2.739 – 5.095	<0.001
Control at work	4.085	2.682 – 5.488	<0.001
Working conditions	3.641	2.562 – 4.720	<0.001

Note: Model fit — $R^2 = 0.727$; Adjusted $R^2 = 0.720$; Root MSE = 5.20

well-being (56.15%), while 32.62% were classified in the high category. The home-work interface domain showed a generally favorable profile, with nearly two-thirds of respondents reporting high scores (68.98%). Similarly, most participants reported high control at work (67.38%), indicating positive perceptions of autonomy and decision-making capacity. Job and career satisfaction was predominantly moderate (50.27%), with over one-third of respondents categorized as high (36.90%). In contrast, working conditions exhibited the least favorable distribution, with more than half of respondents classified in the low category (51.87%). Stress at work was reported as low by 50.27% of respondents, whereas 27.81% experienced high levels of work-related stress.

Bivariate analyses revealed statistically significant associations between overall QoWL and five WRQoL domains. General well-being, home-work interface, job and career satisfaction, control at work, and working conditions were all significantly related to overall QoWL (all $p < 0.001$). In contrast, stress at work was not significantly associated with overall QoWL ($p = 0.345$) (Table 2).

Multiple linear regression analysis showed that all WRQoL domains were significantly associated with overall QoWL. Table 3 showed that the model was statistically significant ($F(5,181) = 96.45$, $p < 0.001$) and explained 72.7% of the variance in QoWL ($R^2 = 0.727$; adjusted $R^2 = 0.720$). Control at work demonstrated the strongest association with QoWL ($\beta = 4.085$; 95% CI: 2.682–5.488; $p < 0.001$), followed by job and career satisfaction ($\beta = 3.917$; 95% CI: 2.739–5.095; $p < 0.001$), home-work interface ($\beta = 3.848$; 95% CI: 2.561–5.135; $p < 0.001$), working conditions ($\beta = 3.641$; 95% CI: 2.562–4.720; $p < 0.001$), and general well-being ($\beta = 1.564$; 95% CI: 0.662–2.465; $p = 0.001$).

DISCUSSION

Respondent characteristics

The majority of respondents in this study were adults aged 30–59 years and predominantly married. In the mining sector, workers within this productive age group commonly hold substantial operational responsibilities and are exposed to demanding work schedules, including extended shifts and rotational systems. These conditions may intensify the interaction between occupational and family roles. Mining employees often experience prolonged separation from family due to remote site locations and shift-based systems, which can influence their perceptions of work–life balance and overall QoWL.

Marital status may further shape QoWL outcomes. Married workers frequently carry dual role expectations, balancing workplace demands with family responsibilities. Research in Indonesian mining companies has demonstrated that workload significantly affects work–life balance, particularly among married employees, where family obligations compound occupational stressors [7]. Therefore, the demographic characteristics in this study are contextually relevant for understanding QoWL patterns in mining environments.

Distribution of WRQoL domains

More than half of the respondents reported low levels of general well-being and working conditions. Mining environments are inherently high-risk and physically demanding, characterized by exposure to noise, vibration, extreme climate, and heavy equipment operations. Such occupational exposures may adversely affect workers' physical and psychological well-being.

Working conditions emerged as the least favorable domain, descriptively, which is consistent with the mining industry's characteristics, where workload intensity, safety climate, fatigue risk, and operational pressures significantly shape work experiences. Prior research in mining settings demonstrates that workload and job stress negatively influence job satisfaction and work–life balance [8]. These structural and environmental stressors may explain the relatively low distribution observed in this domain.

Conversely, high scores in home–work interface and control at work suggest that employees perceive adequate autonomy and role clarity despite operational demands. In mining contexts, structured standard operating procedures and task specialization may enhance perceived job control. Autonomy functions as a job resource that can mitigate the negative effects of

high job demands and enhance QoWL [9]. High-risk work environments also imbalance the home-work interface, affecting workers' health and productivity [10].

Relationship between WRQoL domains and overall QoWL

Bivariate findings demonstrated significant associations between overall QoWL and five WRQoL domains: general well-being, home–work interface, job and career satisfaction, control at work, and working conditions. These findings reinforce the multidimensional nature of QoWL, indicating that both psychosocial and structural job factors collectively shape employees' quality of work life [11].

Multivariate analysis further revealed that working conditions were the strongest independent predictor of higher QoWL, followed by job and career satisfaction. In mining operations, safe physical environments, adequate resources, fair supervision, and manageable workload are critical determinants of occupational well-being. Research on organizational dynamics shows that job satisfaction mediates the relationship between organizational factors, such as reward systems and job security, and employee retention outcomes [12]. Thus, improving structural and career-related aspects may substantially elevate QoWL in high-risk industries.

The paradox of work stress

The absence of an independent association between work-related stress and overall QoWL warrants careful interpretation ($p = 0.134$). In high-risk sectors, stress may be cognitively reframed as a functional component of operational responsibility rather than a detrimental condition. This normalization effect reduces the variance in the perceived stress impact on global work-life evaluation.

First, normalization of stress may be normalized within the mining context. Workers may perceive stress as an inherent and unavoidable consequence of their occupation. In high-risk industries such as mining, exposure to operational pressure, safety vigilance, and production targets may be internalized as part of professional responsibility. Consequently, stress may no longer substantially alter workers' global perceptions of work-life quality because it is cognitively accepted as a normative job demand [12]. Additionally, stress may operate indirectly rather than directly. Evidence from mining studies suggests that workload and stress influence outcomes through mediating mechanisms such as fatigue due to job demands [13].

Second, autonomy as a compensatory buffer may explain this paradox. The relatively high score

observed in the control at the work domain suggests that employees perceive considerable autonomy in task execution and decision-making. According to the job demands–resources perspective, job resources such as autonomy can buffer the negative impact of job demands, including stress on well-being. Employees who experience high control over their work are more capable of regulating workload pressure and coping effectively with stressors. In this study, autonomy may serve as a protective factor, attenuating the direct effect of stress on overall QoWL. [14]. This paradox highlights that stress alone does not automatically determine the quality of work life. Rather, its impact depends on the presence of balancing job resources and contextual perceptions [15].

Model strength and practical interpretation

The explanatory power of the regression model (Pseudo $R^2 = 0.558$) indicates that the WRQoL domains collectively account for a substantial proportion of variance in overall QoWL. This suggests conceptual coherence between the multidimensional WRQoL framework and employees' global evaluation of work life in mining settings. Importantly, the dominance of structural predictors implies that interventions to improve QoWL should prioritize system-level modifications rather than focusing solely on individual stress management programs. Organizational improvements in safety climate, fatigue mitigation systems, supervisory practices, workload allocation, and transparent career pathways are likely to produce measurable gains in overall QoWL. In high-risk industries such as mining, QoWL appears to be shaped by the interplay of structural adequacy, career security, and adaptive psychosocial resources rather than by the mere presence or absence of stress.

Research limitations

This study is subject to time and cost constraints in examining QoWL among operators in the context of family demands and economic vulnerability. The study was conducted over a limited period from June to August 2025; therefore, data were collected only once using a cross-sectional approach. This research used purposive sampling and focused solely on operators, which may limit the generalizability of the findings to other occupational groups. In addition, the data were collected via self-report questionnaires using the WRQoL Scale, which may introduce response bias.

From an analytical perspective, this study used a composite QoWL score derived from the same WRQoL domains as those included in the analysis, which may introduce a part–whole correlation. Although this approach allows examination of relative domain

contributions, it may not fully capture the latent structure of QoWL. Future research is recommended to employ advanced analytical methods, such as structural equation modeling (SEM), to better capture the hierarchical and multidimensional nature of WRQoL.

Methodological considerations

This study constructed the overall QoWL score by summing all WRQoL domains in accordance with the instrument's standard framework. It is acknowledged that using these domains as explanatory variables may introduce part–whole correlation; therefore, the findings are interpreted as reflecting the relative contribution and structural associations of each domain rather than independent causal effects. For descriptive purposes, WRQoL scores were categorized into low, moderate, and high levels using tertiles, whereas inferential analyses treated all variables as continuous to preserve statistical information. The WRQoL instrument demonstrated excellent internal consistency (Cronbach's $\alpha = 0.908$), and standard regression assumptions, including linearity, normality, and absence of multicollinearity, were assessed and met. Missing data were handled using listwise deletion. Nevertheless, the absence of additional work-related variables, such as tenure and shift patterns, and the use of a cross-sectional self-report design may introduce bias and limit causal inference. Future studies are recommended to employ more advanced analytical approaches, such as structural equation modeling, to better capture the latent, multidimensional nature of QoWL.

CONCLUSION

From this study, it can be concluded that overall QoWL among mining employees is significantly associated with multiple WRQoL domains, including general well-being, home–work interface, job and career satisfaction, control at work, and working conditions (all $p < 0.001$). In contrast, stress at work was not significantly associated with overall QoWL ($p = 0.168$). Among the examined domains, home–work interface, control at work, and job and career satisfaction demonstrated the strongest relative contributions to QoWL, highlighting the importance of work–life balance, autonomy, and career-related factors in shaping employees' perceptions of work-life quality.

From a practical perspective, these findings suggest that improving QoWL in mining environments requires a comprehensive approach integrating structural and psychosocial interventions. Mining companies are

encouraged to prioritize improvements in working conditions, fatigue management systems, and career development pathways. In addition, organizational policies that promote work–life balance and support employee autonomy should be strengthened to sustain workforce well–being. Such strategies are essential not only for enhancing employees’ quality of life but also for improving productivity and ensuring long-term organizational sustainability in high-risk industries.

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Authors’ contributions

G.S.A.: Conceptualization, Methodology, Data curation, Investigation, Visualization, Writing – original draft, Writing – review & editing; A.A.: Conceptualization, Methodology, Formal analysis, Software, Validation, Writing – review & editing; J.S.: Conceptualization, Validation, Writing – review & editing; E.Y.: Investigation, Resources, Literature review, Writing – review & editing; A.P.P. P: Supervision, Methodology, Writing – review & editing; A.U.R.: Supervision, Methodology, Writing – review & editing; A.B.L.: Resources, Data curation, Project administration. All authors have read and approved the final manuscript.

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Data availability

The data that support the findings of this study were obtained from a mining company and are not publicly available due to confidentiality restrictions. Data may be made available from the corresponding author upon reasonable request and with permission from the company.

Ethics statement

This study utilized secondary data collected as part of routine company assessments. Ethical approval was obtained from the Ethics Committee of the Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada (Ref. No.: KE/FK/1945/EC/2025). The dataset was provided in an anonymized form, and no personally identifiable information was accessible to the researchers. Informed consent had been obtained from all participants by the company at the time of the original data collection.

Conflicts of interest

The authors declare no conflict of interest regarding the publication of this article.

Use of artificial intelligence (AI)

Portions of this manuscript were edited using ChatGPT to improve grammar and clarity. All AI-assisted content was

carefully reviewed and validated by the authors, who take full responsibility for the final manuscript.

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