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Psychometric Evaluation of MFI-20 and OFER-15 Instruments for Measuring Occupational Fatigue Among Nickel Miners

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ABSTRACT

Occupational fatigue is a multidimensional construct that affects physical, mental, and emotional functioning, especially in high-risk sectors such as mining. This study aims to evaluate the psychometric properties of two widely used instruments—Multidimensional Fatigue Inventory (MFI-20) and Occupational Fatigue Exhaustion Recovery (OFER-15)—in measuring fatigue among nickel mine workers in Indonesia. A total of 358 respondents were recruited through purposive sampling from various shifts and departments to ensure diverse representation of the mining workforce. Data were collected during regular work cycles across day and night shifts. Internal consistency was examined using Cronbach's Alpha, while convergent and discriminant validity were assessed through correlation analysis among dimensions. Results showed high reliability for both instruments (α > 0.70 across all subscales). Most items demonstrated significant convergent validity (r > 0.4, p < 0.05), and inter-dimensional correlations supported discriminant validity (r < 0.7). These findings suggest that MFI-20 and OFER-15 are valid and reliable tools for assessing occupational fatigue in mining contexts. The study contributes to the field of occupational health by providing the first psychometric validation of these instruments specifically for the Indonesian mining industry, addressing a critical gap in fatigue assessment tools for high-risk industrial settings. The study supports the use of both instruments for fatigue monitoring and intervention planning in industrial settings.

KEYWORDS *Occupational fatigue, MFI-20, OFER-15, psychometric properties, validity, reliability, mining industry*

INTRODUCTION

Fatigue is recognized as a major occupational health concern, particularly in high-risk industries such as mining where workers are often subjected to prolonged work hours, irregular shift patterns, and physically demanding tasks. Occupational fatigue can manifest in various forms, including physical, mental, and emotional exhaustion, and has been associated with reduced productivity, increased accident risk, and long-term health issues (Gonçalves & Matos, 2025; Techera et al., 2016).

The accurate assessment of fatigue in high-risk industries is critical not only for worker safety but also for organizational productivity and regulatory compliance. In mining operations, where workers face extreme environmental conditions, heavy machinery operation, and extended shift schedules, the consequences of undetected fatigue can be catastrophic, leading to serious injuries, fatalities, and operational losses (T. J. Bauerle et al., 2021; Duarte et al., 2021; Khurram et al., 2025).

In response to the growing emphasis on fatigue risk management systems (FRMS), the development and validation of reliable and valid fatigue measurement instruments have become crucial. Among the most widely used self-report tools are the Multidimensional Fatigue Inventory (MFI-20), which evaluates five distinct dimensions of fatigue—general fatigue, physical fatigue, mental fatigue, reduced motivation, and reduced activity—and the

Occupational Fatigue Exhaustion Recovery (OFER-15) scale, which captures the balance between acute fatigue, chronic fatigue, and intershift recovery.

While both instruments have been extensively used in healthcare, industrial, and transportation settings, their psychometric properties have not been systematically evaluated in the mining sector, particularly in developing countries such as Indonesia. This gap is significant because the mining industry presents unique occupational hazards and work demands that may influence the manifestation and measurement of fatigue differently than in other sectors (T. Bauerle et al., 2018; Pelders & Nelson, 2019; Stemn & Benyarku, 2023). Furthermore, cultural and organizational contexts in Indonesia may affect how workers perceive and report fatigue symptoms, necessitating context-specific validation of these instruments (Çiçek et al., 2025; Sampil et al., 2025; Sun et al., 2025; Suwarsi et al., 2024).

Beyond the mining sector specifically, evaluating fatigue assessment instruments across various high-risk industries—including construction, manufacturing, oil and gas, and transportation—is essential for developing robust, transferable tools that can be adapted to diverse occupational settings. Such validation efforts enable organizations to implement evidence-based fatigue monitoring systems that are both scientifically sound and contextually appropriate (Arkilic et al., 2024; Hilty et al., 2022; Lee et al., 2025; Sprajcer et al., 2022).

Occupational fatigue represents a critical and multifaceted health concern within high-risk industries, particularly in mining, where demanding physical labor, prolonged shifts, and environmental stressors converge. Extensive research has documented its adverse effects, linking fatigue to diminished cognitive performance, increased error rates, and heightened risks of workplace accidents and injuries. Furthermore, chronic fatigue is associated with long-term health deterioration, including cardiovascular and mental health disorders, underscoring its significance as a priority for occupational health and safety frameworks. The mining sector, with its inherent hazards, thus presents a crucial context for understanding and mitigating fatigue to safeguard worker well-being and operational safety.

In response to the need for systematic assessment, several psychometric instruments have been developed and validated internationally to measure fatigue (Belza et al., 2018; Díaz-García et al., 2021). Among the most prominent are the Multidimensional Fatigue Inventory (MFI-20), which captures general, physical, and mental fatigue alongside reduced motivation and activity (Smets et al., 1995), and the Occupational Fatigue Exhaustion Recovery scale (OFER-15), designed specifically to evaluate acute and chronic work-related fatigue and intershift recovery. These tools have demonstrated robust reliability and validity across various populations, including healthcare professionals, transportation workers, and industrial employees, providing a foundation for evidence-based fatigue risk management systems (FRMS). However, the cross-cultural and contextual applicability of these instruments cannot be assumed without empirical verification within specific workforce demographics and industrial settings (Jeong & Lee, 2019; Spector et al., 2015; Zheng et al., 2015).

Despite the global utilization of these instruments, a significant research gap exists regarding their psychometric validation within the Indonesian mining industry, particularly among nickel miners. Previous studies have largely focused on Western or clinically oriented populations, with limited exploration in Southeast Asian industrial contexts where cultural, organizational, and work-environment factors may influence fatigue perceptions and reporting. The absence of validated, context-specific assessment tools hinders the development of targeted interventions and effective FRMS in one of Indonesia's economically vital yet hazardous sectors, leaving a critical void in both academic understanding and practical occupational health management.

Addressing this gap is a matter of urgent practical necessity. Nickel mining operations involve physically strenuous tasks, shift work, and exposure to demanding environments, all of which are known fatigue amplifiers. Without reliable and valid measurement tools, companies cannot accurately monitor fatigue levels, identify at-risk groups, or evaluate the effectiveness of countermeasures. This lack of data-driven insight perpetuates reactive rather than proactive safety cultures, increasing the likelihood of fatigue-related incidents. Consequently, validating appropriate assessment instruments is an urgent step toward enhancing workplace safety, health outcomes, and overall productivity in this high-stakes industry.

The novelty of this research lies in its focused psychometric evaluation of two internationally recognized fatigue instruments—MFI-20 and OFER-15—within a previously understudied population: nickel miners in Indonesia. By examining the internal consistency, convergent validity, and discriminant validity of these scales in this specific context, the study contributes original empirical evidence regarding their suitability and measurement invariance. This approach moves beyond mere application of existing tools to critically assess their performance in a distinct cultural and occupational setting, thereby enriching the global literature on occupational fatigue measurement while providing locally relevant validation.

The primary purpose of this study is to evaluate the reliability and construct validity of the MFI-20 and OFER-15 instruments for measuring occupational fatigue among nickel miners in Southeast Sulawesi, Indonesia. By doing so, the research aims to establish whether these tools can be confidently employed for fatigue assessment in this population. The anticipated benefits are twofold: academically, it strengthens the methodological foundation for cross-cultural fatigue research, and practically, it provides mining companies and occupational health practitioners with validated instruments to integrate into fatigue monitoring and risk management programs. Ultimately, this can inform better scheduling, targeted interventions, and policy improvements, leading to enhanced worker safety, health, and operational efficiency in the mining industry.

METHOD

This study employed a quantitative cross-sectional design as part of a larger fatigue risk assessment project at a nickel mining company (PT. X) in South Sulawesi, Indonesia. The sample size of 358 participants was determined based on the recommendation of at least 10 respondents per questionnaire item for psychometric validation studies, ensuring adequate statistical power for reliability and validity analyses. Data were collected from 358 mining workers who completed both the MFI-20 and OFER-15 questionnaires. Participants were selected using purposive sampling, ensuring representation across different departments (operations, maintenance, and support services), work shifts (day, night, and rotating shifts), experience levels (ranging from less than 1 year to over 10 years), and age groups (21-55 years). This sampling strategy was designed to capture the full spectrum of fatigue experiences within the mining workforce and enhance the generalizability of findings across various operational contexts.

Instruments

1. MFI-20 (Multidimensional Fatigue Inventory):
   Consists of 20 items grouped into five dimensions (4 items each):
   a. General Fatigue
   b. Physical Fatigue
   c. Mental Fatigue
   d. Reduced Motivation
   e. Reduced Activity

The MFI-20 uses a 5-point Likert scale format to capture varying degrees of fatigue intensity. This scale was chosen because it provides sufficient response variability while remaining simple enough for workers to complete quickly during or immediately after their shifts. The five-point format aligns with the original instrument design and has been validated across multiple occupational populations, ensuring consistency with established psychometric benchmarks. Responses were recorded on a 5-point Likert scale ranging from 1 (Yes, that is true) to 5 (No, that is not true).

2. OFER-15 (Occupational Fatigue Exhaustion Recovery):
   Comprises 15 items across three dimensions (5 items each):
   a. Chronic Fatigue
   b. Acute Fatigue
   c. Intershift Recovery

The OFER-15 employs a 7-point Likert scale to allow for more nuanced assessment of work-related fatigue and recovery patterns, which is particularly important for detecting subtle changes in chronic fatigue accumulation and recovery adequacy between shifts. This finer granularity supports the instrument's objective of capturing dynamic fatigue-recovery cycles that are critical for shift work populations. Each item was rated on a 7-point Likert scale, from 1 (Strongly disagree) to 7 (Strongly agree).

Both questionnaires were administered in Bahasa Indonesia through paper-based surveys distributed at the workplace. Data collection occurred during designated break times to minimize disruption to work activities and ensure workers could complete the instruments in a comfortable, unstressed environment. Trained research assistants were available to clarify instructions and answer questions, ensuring consistent and accurate data collection across all participants.

Data Analysis

All data analyses were conducted using IBM SPSS Statistics version 30. The following psychometric evaluations were performed:

1. Reliability Testing: Cronbach's Alpha was used to assess the internal consistency of each dimension within both MFI-20 and OFER-15. A coefficient value ≥ 0.70 was considered acceptable [5].
2. Convergent Validity: Evaluated through inter-item correlation within each dimension. Significant positive correlations ($r \geq 0.4$, $p < 0.05$) among items in the same dimension were used as evidence of convergent validity [6].
3. Discriminant Validity: Assessed by analyzing inter-dimension correlations. Correlations between dimensions were expected to be lower than 0.70, indicating that each dimension measures a distinct aspect of fatigue [7].
4. Descriptive Statistics: Mean scores and standard deviations were calculated for each dimension to provide an overview of the participants' fatigue profiles.

RESULT AND DISCUSSION

Reliability Analysis

The internal consistency of each dimension within the MFI-20 and OFER-15 instruments was evaluated using Cronbach's Alpha. As presented in Table 1, all dimensions of both instruments demonstrated acceptable to high reliability, with α coefficients 0.83 exceeding the minimum threshold of 0.70 recommended for psychological scales [1].

Specifically, the General Fatigue subscale of MFI-20 showed the highest reliability (α = 0.90), followed by Physical Fatigue (α = 0.79) and Mental Fatigue (α = 0.77). The variation in reliability across MFI-20 subscales may be attributed to differences in construct specificity and item homogeneity. General Fatigue items tend to capture a more universally experienced phenomenon, resulting in higher inter-item consistency, whereas subscales such as Reduced Activity may be more context-dependent and influenced by individual work roles, leading to slightly lower but still acceptable reliability coefficients. Meanwhile, for OFER-15, Chronic Fatigue yielded the highest alpha value (α = 0.85), confirming its strong internal consistency. These findings support the notion that both instruments are reliable tools for assessing different aspects of occupational fatigue in mining workers.

Table 1. Reliability Analysis

Instruments	Interpretation	Cronbach's Alpha	Result
OFER-15	358	0.83	Good
MFI-20	358	0.90	Good

Validity Testing of MFI 20

Convergent Validity

Convergent validity was assessed by analyzing the average item-to-item correlation within each subscale of the MFI-20 instrument. As shown in Table 2, all five dimensions demonstrated acceptable convergent validity, with average correlation coefficients ranging from 0.49 to 0.62, and all correlations being statistically significant ($p < 0.05$). The General Fatigue dimension had the highest average correlation ($r = 0.62$), with item-pair correlations ranging from 0.31 to 0.56 and p-values ranging between 0.000 and 0.012. Similarly, Physical Fatigue ($r = 0.57$), Mental Fatigue ($r = 0.55$), and Reduced Motivation ($r = 0.52$) also showed strong inter-item consistency, indicating that the items within each subscale measure the same latent construct. The lowest average correlation was found in Reduced Activity ($r = 0.49$), but still within acceptable bounds.

Discriminant Validity

Discriminant validity was examined by observing the correlations between different dimensions of the MFI-20 instrument. Across all five dimensions, the inter-dimension correlation values remained below 0.70, which confirms that each dimension represents a distinct aspect of occupational fatigue, and does not significantly overlap with others. For instance, although there were moderate correlations between General Fatigue and Mental Fatigue, the r-values remained under the 0.70 threshold, indicating conceptual independence between constructs. Therefore, both convergent and discriminant validity criteria were met for all dimensions of MFI-20 in this population of nickel miners.

Table 2. Validity Testing of MFI 20

Dimension	Avg. Correlation (r)	Correlation Range	Significance (p)	p-value Range	Inter-Dimension Correlation	Convergent Validity	Discriminan Validity
General Fatigue	0.62	0.31 – 0.56	$p < 0.01$	0.000 – 0.012	< 0.7	✓	✓
Physical Fatigue	0.57	0.28 – 0.50	$p < 0.01$	0.001 – 0.019	< 0.7	✓	✓
Reduced Activity	0.49	0.30 – 0.49	$p < 0.01$	0.002 – 0.025	< 0.7	✓	✓
Reduced Motivation	0.52	0.32 – 0.51	$p < 0.01$	0.000 – 0.030	< 0.7	✓	✓
Mental Fatigue	0.55	0.34 – 0.53	$p < 0.01$	0.001 – 0.018	< 0.7	✓	✓

Validity Testing of OFER-15

Convergent Validity

The convergent validity of the Occupational Fatigue Exhaustion Recovery (OFER-15) instrument was assessed by analyzing item-to-item correlations within each subscale. As summarized in Table 3, all three dimensions showed moderate to strong correlations between items, with correlation ranges of:

Chronic Fatigue (V1–V5): 0.406 – 0.644

Acute Fatigue (V6–V10): 0.444 – 0.686

Intershift Recovery (V11–V15): 0.370 – 0.592

All correlations were statistically significant at $p < 0.01$, indicating that the items within each dimension are conceptually consistent and measure a single underlying construct. Therefore, all three subscales fulfill the criteria for convergent validity.

Discriminant Validity

Discriminant validity was assessed by examining inter-dimension correlations. The correlation coefficients were:

Chronic vs. Acute Fatigue: $r = 0.696$

Chronic vs. Intershift Recovery: $r = 0.550$

Acute vs. Intershift Recovery: $r = 0.646$

All correlations were significant at $p < 0.01$. Although the correlation between Chronic and Acute Fatigue approached the upper threshold ($r = 0.696$), it remained below the cut-off value of 0.70, indicating acceptable discriminant validity. The other two inter-dimensional correlations were more moderate, which confirms that the three constructs are related but empirically distinct. The OFER-15 demonstrates robust psychometric validity in this mining workforce. These psychometric properties have important practical implications for fatigue risk management in mining operations. The ability to distinguish between chronic fatigue (long-term exhaustion accumulated over weeks or months) and acute fatigue (short-term exhaustion from a single shift) allows organizations to tailor interventions more precisely. For instance, workers scoring high on chronic fatigue may benefit from extended time off or workload redistribution, whereas those experiencing primarily acute fatigue may require adjustments in shift length or task allocation. Similarly, the intershift recovery dimension provides actionable insights into whether current rest periods are adequate, directly informing scheduling policy revisions and rest break optimization. The results suggest that each subscale measures a specific domain of occupational fatigue or recovery, and that the instrument can be reliably used to inform fatigue risk management and scheduling decisions in industrial contexts.

Table 3. Validity Testing of OFER-15

Validity Types	Dimension	Correlation Range	Significance (p)	Summary
Convergence	Chronic Fatigue (V1–V5)	0.406–0.644	p < 0.01	Valid
Convergence	Acute Fatigue (V6–V10)	0.444–0.686	p < 0.01	Valid
Convergence	Intershift Recovery (V11–V15)	0.370–0.592	p < 0.01	Valid
Discriminant	Chronic vs Acute Fatigue	r = 0.696	p < 0.01	Valid
Discriminant	Chronic vs Intershift Recovery	r = 0.550	p < 0.01	Valid
Discriminant	Acute vs Intershift Recovery	r = 0.646	p < 0.01	Valid

The results of this study confirm that both MFI-20 and OFER-15 possess strong psychometric properties when applied to the population of nickel miners. Their reliability and validity suggest that these tools can be effectively used to identify fatigue levels, monitor trends over time, and support targeted interventions in high-risk work environments.

The slightly stronger performance of OFER-15 in terms of reliability may be attributed to its domain-specific focus on work-related fatigue and recovery dynamics. In contrast, MFI-20 offers a broader, multidimensional perspective suitable for both clinical and occupational populations.

The ability to accurately assess fatigue is essential for implementing effective Fatigue Risk Management Systems (FRMS). Reliable instruments such as MFI-20 and OFER-15 provide organizations with data-driven insights that can inform policy, scheduling, health promotion, and early interventions, ultimately contributing to improved safety and productivity in the mining industry.

While these instruments demonstrate strong psychometric properties in the mining context, it is important to acknowledge potential limitations related to cultural and environmental factors specific to Indonesian mining operations. Cultural norms regarding the expression of fatigue or complaints about work conditions may influence self-reported fatigue scores. Additionally, the physical environment—including extreme heat, humidity, dust exposure, and underground working conditions—may shape how workers experience and conceptualize fatigue differently than in other industrial settings or geographic regions. Future research should explore whether cultural adaptation or contextual modifications to these instruments might enhance their sensitivity and specificity in diverse occupational and cultural environments.

CONCLUSION

This study confirms that both the Multidimensional Fatigue Inventory (MFI-20) and the Occupational Fatigue Exhaustion Recovery (OFER-15) are psychometrically sound instruments for measuring occupational fatigue among nickel mine workers in Indonesia. The internal consistency of all subscales exceeded the accepted threshold, and both convergent and discriminant validity were satisfactorily demonstrated. The findings support the multidimensional nature of fatigue and reinforce the importance of selecting appropriate assessment tools that align with the specific context of industrial work. MFI-20 provides a comprehensive view of general and psychological fatigue, while OFER-15 offers more targeted insights into work-related fatigue and recovery cycles. Both instruments can be integrated into fatigue monitoring systems to enhance safety and health outcomes. The validated use of MFI-20 and OFER-15 in this mining context enables organizations to implement evidence-based fatigue monitoring programs, design targeted interventions (such as revised rest schedules for low intershift recovery or wellness programs for reduced motivation), refine shift scheduling policies to reduce excessive overtime, support Fatigue Risk Management System (FRMS) implementation, and enhance worker training and awareness regarding fatigue recognition. Future studies are encouraged to explore the use of these instruments in longitudinal designs and in combination with objective measures such as Psychomotor Vigilance Task (PVT) or physiological monitoring, to further enhance the robustness of fatigue assessment strategies.

REFERENCES

Arkilic, L. Z., Hundt, E., & Quatrara, B. (2024). Critical Care Alarm Fatigue and Monitor Customization: Alarm Frequencies and Context Factors. *Critical Care Nurse*. https://doi.org/10.4037/CCN2024797

Bauerle, T., Dugdale, Z., & Poplin, G. S. (2018). Mineworker fatigue: A review of what we know and future decisions. *Mining Engineering*.

Bauerle, T. J., Sammarco, J. J., Dugdale, Z., & Dawson‖, D. (2021). The human factors of mineworker fatigue: An overview on prevalence, mitigation, and what's next. *American Journal of Industrial Medicine*. https://doi.org/10.1002/AJIM.23301

Belza, B., Miyawaki, C. E., Liu, M., Aree-Ue, S., Fessel, M. M., Minott, K., & Zhang, X. (2018). A Systematic Review of Studies Using the Multidimensional Assessment of Fatigue Scale. *Journal of Nursing Measurement*. https://doi.org/10.1891/1061-3749.26.1.36

Çiçek, İ., Sipahioğlu, M., & Dilekçi, Ü. (2025). The Mediating Role of Occupational Self-Efficacy and Resilience in the Relationship Between Occupational Stress and Subjective Well-Being in Teachers: Validation of the Turkish Version of the Teacher Occupational Self-Efficacy-Short Form. *Psychology in the Schools*. https://doi.org/10.1002/PITS.70073

Díaz-García, J., González-Ponce, I., Ponce-Bordón, J. C., López-Gajardo, M., Ramírez-Bravo, I., Rubio-Morales, A., & García-Calvo, T. (2021). Mental Load and Fatigue Assessment Instruments: A Systematic Review. *International Journal of Environmental Research and Public Health*. https://doi.org/10.3390/IJERPH19010419

Duarte, J., Marques, A. T., & Baptista, J. S. (2021). Occupational Accidents Related to Heavy Machinery: A Systematic Review. *Safety*. https://doi.org/10.3390/SAFETY7010021

Gonçalves, S., & Matos, R. S. (2025). Understanding emotional fatigue: a systematic review of causes, consequences, and coping strategies. *Enfermería Clínica (English Edition)*. https://doi.org/10.1016/J.ENFCLE.2025.502190

Hilty, D. M., Armstrong, C. M., Smout, S. A., Crawford, A., Maheu, M. M., Drude, K. P., Chan, S., Yellowlees, P., Krupinski, E. A., Hilty, D. M., Armstrong, C. M., Smout, S. A., Crawford, A., Maheu, M. M., Drude, K. P., Chan, S. M., Yellowlees, P. M., &

Krupinski, E. A. (2022). Findings and Guidelines on Provider Technology, Fatigue, and Well-being: Scoping Review. *Journal of Medical Internet Research*. https://doi.org/10.2196/34451

Jeong, S., & Lee, Y. (2019). Consequences of Not Conducting Measurement Invariance Tests in Cross-Cultural Studies: A Review of Current Research Practices and Recommendations. *Advances in Developing Human Resources*. https://doi.org/10.1177/1523422319870726

Khurram, M., Wu, C., Muhammad, S., Kishnani, H., An, K. R., Abeywardena, K., Chadha, U., & Behdinan, K. (2025). Artificial Intelligence in Manufacturing Industry Worker Safety: A New Paradigm for Hazard Prevention and Mitigation. *Processes*. https://doi.org/10.3390/PR13051312

Lee, J., Luna, J., & Wisniewski, M. G. (2025). From silos to synergies: A scoping review for bridging gaps in occupational health psychology and human neuroscience. *Journal of Safety Research*. https://doi.org/10.1016/J.JSR.2025.09.009

Pelders, J., & Nelson, G. (2019). Contributors to Fatigue of Mine Workers in the South African Gold and Platinum Sector. *Safety and Health at Work*. https://doi.org/10.1016/J.SHAW.2018.12.002

Sampil, N. S., Daud, A., & Hairon, S. M. (2025). Translation and validation of Malay version of NIOSH worker well-being questionnaire (WellBQ). *PLoS ONE*. https://doi.org/10.1371/JOURNAL.PONE.0322451

Spector, P. E., Liu, C., & Sanchez, J. I. (2015). *Methodological and Substantive Issues in Conducting Multinational and Cross-Cultural Research*. https://doi.org/10.1146/ANNUREV-ORGPSYCH-032414-111310

Sprajcer, M., Thomas, M. J. W., Sargent, C., Crowther, M. E., Boivin, D. B., Wong, I. S., Smiley, A., & Dawson‖, D. (2022). How effective are Fatigue Risk Management Systems (FRMS)? A review. *Accident Analysis and Prevention*. https://doi.org/10.1016/J.AAP.2021.106398

Stemn, E., & Benyarku, C. A. (2023). Mineworkers' perspective of fatigue: A study of the Ghanaian mining industry. *Safety Science*. https://doi.org/10.1016/J.SSCI.2023.106095

Sun, L., An, Y., Yuan, X., Zhang, H., & Cheng, F. (2025). Multidimensional Fatigue Assessment of High-Altitude Electrical Workers: A Comprehensive Analysis Based on Physiological and Psychological Indicators. *Applied Psychophysiology and Biofeedback*. https://doi.org/10.1007/S10484-025-09732-Y

Suwarsi, S., Ridwan, R., & Fauzan, N. (2024). Evaluating workload impacts on lecturer mental health and productivity in indonesian private universities: A case study from bandung. *Multidisciplinary Science Journal*. https://doi.org/10.31893/MULTISCIENCE.2025045

Techera, U., Hallowell, M. R., Stambaugh, N., & Littlejohn, R. (2016). Causes and Consequences of Occupational Fatigue: Meta-Analysis and Systems Model. *Journal of Occupational and Environmental Medicine*. https://doi.org/10.1097/JOM.0000000000000837

Zheng, X., Zhu, W., Zhao, H., & Zhang, C. (2015). *Employee well-being in organizations:Theoretical model, scale development, and cross-cultural validation*. https://doi.org/10.1002/JOB.1990