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Return-to-Work Assessment for Traditional Tin Miners with Tuberculosis and Pneumoconiosis: A Case Report Using PERDOKI's 7-Step Fit-to-Work Method

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Abstract

Background: Workers involved in Indonesia's traditional tin mining face significant risks of developing pneumoconiosis, primarily due to persistent exposure to ore dust. Striking a balance between maintaining productivity and safeguarding worker health is essential. Implementing structured return-to-work evaluations becomes crucial for monitoring health outcomes and ensuring safer working conditions.
Case: A 38-year-old male with a one-year history of surface tin mining presented with a persistent cough and worsening shortness of breath. Imaging revealed bilateral nodular opacities, findings consistent with pneumoconiosis. Spirometry demonstrated a restrictive ventilatory defect. No significant comorbidities were identified.
Methods: The seven-step PERDOKI protocol was used to assess fitness to work (FTW): (1) task analysis, (2) job demand assessment, (3) medical status evaluation, (4) disability evaluation, (5) risk analysis, (6) environmental tolerance evaluation, and (7) final FTW decision.
Results: The miner does not meet the required 7.9 METs threshold for physical capacity. Consequently, he has been classified as "temporarily unfit as a miner." Medical recommendations include ongoing treatment and a gradual return-to-work schedule, along with regular pulmonary assessments.
Conclusion: The PERDOKI 7-step protocol serves as a structured, evidence-based approach to assessing whether a tin miner with pneumoconiosis is ready to return to work. Rather than a one-size-fits-all solution, this protocol emphasizes careful health monitoring and tailored job modifications.
Keyword: pneumoconiosis, tin mine worker, return to work, fitness to work, occupational lung disease, PERDOKI

Abstrak

Latar belakang: *Pekerja pada sektor pertambangan timah tradisional di Indonesia memiliki risiko tinggi mengalami pneumokoniosis akibat pajanan debu material tambang secara kronis. Keseimbangan antara produktivitas dan perlindungan kesehatan pekerja sangat penting. Oleh karena itu, evaluasi kembali bekerja (return-to-work/RTW) yang terstruktur menjadi krusial untuk memantau kondisi kesehatan dan menjamin keselamatan kerja.*
Kasus: *Seorang laki-laki usia 38 tahun dengan riwayat bekerja satu tahun sebagai penambang timah permukaan datang dengan keluhan batuk persisten dan sesak napas yang semakin memberat. Pemeriksaan pencitraan menunjukkan opasitas nodular bilateral yang konsisten dengan pneumokoniosis. Spirometri menunjukkan gangguan ventilasi pola restriktif. Tidak ditemukan komorbiditas bermakna.*
Metode: *Penilaian kelayakan kerja (fitness to work/FTW) dilakukan menggunakan protokol tujuh langkah PERDOKI yang meliputi: (1) analisis tugas, (2) penilaian tuntutan pekerjaan, (3) evaluasi status medis, (4) penilaian disabilitas, (5) analisis risiko, (6) evaluasi toleransi lingkungan kerja, dan (7) penentuan akhir kelayakan kerja.*
Hasil: *Pekerja tidak memenuhi kapasitas fisik minimal yang dipersyaratkan sebesar 7,9 METs. Oleh karena itu, pasien diklasifikasikan sebagai "sementara tidak layak bekerja sebagai penambang." Rekomendasi medis meliputi terapi lanjutan dan program kembali bekerja secara bertahap disertai pemantauan fungsi paru secara berkala.*
Kesimpulan: *Protokol tujuh langkah PERDOKI merupakan pendekatan terstruktur berbasis bukti untuk menilai kesiapan kembali bekerja pada penambang timah dengan pneumokoniosis. Pendekatan ini menekankan pemantauan kesehatan yang cermat dan modifikasi pekerjaan yang disesuaikan dengan kondisi individu.*
Kata kunci: *pneumokoniosis, penambang timah, kembali bekerja, kelayakan kerja, penyakit paru akibat kerja, PERDOKI*

Background

Uncontrolled open-pit mining operations have spread across Indonesia, causing an environmental and public health crisis. Small-scale and unofficial open-pit mines, especially those that extract gold, coal, and tin, operate with almost no oversight, while large-scale corporate mining projects are subject to rigorous environmental assessments.[1] There are no comprehensive environmental impact studies to evaluate the harm caused by these sites, which are often abandoned after extraction, leaving behind degraded landscapes and untreated toxic runoff.[1, 2]

Although this sector remains important, frequent inhalation of fine tin ore dust—which includes silica and other mineral particles—poses serious respiratory dangers. Long-term exposure can cause pneumoconiosis, an irreversible lung disease that severely reduces work ability and quality of life.[3] Chronic exposure to respirable crystalline silica is a well-established cause of pneumoconiosis and remains a major occupational health concern in mining industries worldwide. In traditional and small-scale tin mining, inadequate dust control and limited occupational health surveillance further increase the risk of silica-related lung disease among workers.[9,10] Pneumoconiosis remains a significant occupational health concern. In 2021, roughly 62,866 new diagnoses and 18,323 deaths (age-standardized incidence: 0.736 per 100,000; mortality: 0.219 per 100,000). The disease is most common in East Asia and countries with a middle-high sociodemographic index, where silicosis makes up nearly 90% of all pneumoconiosis cases.[4]

Although few national statistics are currently available, a systematic review of Asian coal miners found that the prevalence was 9.18%, which is roughly four times higher than the global average and indicates a substantial burden on Indonesian workers. Despite a very low recovery rate, management continues to focus on symptomatic care, medical support, and exposure prevention. Its effects include chronic illness, reduced quality of life, and a significant financial and social burden.[4, 5]

Occupational doctors must balance the risk of disease progression with the need for worker reintegration. Structured return-to-work (RTW) evaluations, such as the PERDOKI 7-step fit-for-work (FTW) protocol, provide a comprehensive approach that considers risk, job demands, health, and workplace tolerance before determining fitness for work.[6]

This case report describes the clinical findings, the step-by-step evaluation, and the RTW plan that resulted from applying the PERDOKI protocol to a traditional tin miner diagnosed with pneumoconiosis.

Case Presentation

Mr. M is a 38-year-old man with a one-year work history at a surface tin mine, presenting with a persistent productive cough and gradually worsening exertional dyspnea over the past month, corresponding to modified Medical Research Council (mMRC) grade 2. He denies hemoptysis but reports intermittent chest tightness. His previous tobacco exposure totals ten pack-years; he quit smoking five years ago.

On examination, vital signs were within normal limits (heart rate 78 bpm, blood pressure 118/78 mmHg, oxygen saturation 94% while receiving four liters of oxygen via nasal cannula). No digital clubbing observed, and pulmonary auscultation showed bibasilar crackles and reduced chest expansion.

Chest radiography revealed diffuse nodular opacities mainly in the upper lobes. High-resolution computed tomography confirmed confluent nodules and subpleural fibrosis, typical of silicosis. Pulmonary function tests showed a restrictive pattern (FEV_1 62% predicted, FVC 65% predicted, FEV_1/FVC 0.96), with a diffusion capacity reduced to 55% of predicted. No significant comorbidities were found. During the six-minute walk test, he covered 352 meters and desaturated to 90%. Laboratory results were unremarkable.

Discussion

Returning to work while managing pneumoconiosis demands a proactive, integrated strategy that prioritizes prevention, early intervention, and worker wellbeing. Without timely and effective measures, continued exposure risks irreversible lung damage, a reduced quality of life, and widening health disparities among mining communities. To address these challenges, We used the PERDOKI 7-step fit-for-work protocol (Perhimpunan Spesialis Kedokteran Okupasi, 2019), which is the standard framework for assessing occupational fitness, to determine the patient's suitability for employment. These steps include: (1) Job Description: a detailed outline of the tasks and responsibilities of the position;

(2) Job Demand: an examination of the physical, mental, sensory, and environmental requirements; (3) Medical Status: an evaluation of the employee's health; (4) Disability Status: an assessment of any functional limitations; (5) Risk Evaluation: identification of potential risks to the employee, coworkers, or the workplace; (6) Tolerance: an evaluation of the support and acceptance from colleagues and supervisors regarding the employee's capabilities; and (7) Fit-for-Work Determination – the final classification of the worker's fitness for duty.[6]

The first step, Job description - His daily duties include handling and transporting ore bags weighing more than 10 kg, as well as operating and maintaining drilling and blasting equipment. He was exposed to long periods of standing and walking on uneven, poorly lit terrain, frequent exposure to high concentrations of mineral ore dust, and vibration from heavy machinery.

Second, Job Demand – The physical requirements of a miner's job include maintaining prolonged upright postures, performing repetitive heavy lifting, and enduring whole-body vibration, all of which challenge musculoskeletal endurance. The patient must be capable of operating heavy tools (≈6.3 METs) and engaging in moderate walking and load carrying (≈3.8–4.5 METs) to meet the minimum physical capacity of 7.9 METs. They need high mobility to move across the mine site, climb ladders, and navigate confined shafts, as well as sufficient muscle strength in all four limbs to handle heavy buckets and jackhammers. Fine motor coordination must be precise enough to operate heavy machinery without tremors or allodynia, and gross motor skills must allow for unrestricted joint movement and a secure grip. A full visual field, corrected distant visual acuity of at least 6/12 in both eyes, adequate near vision, and normal contrast sensitivity are essential; hearing must enable clear communication at approximately 6 meters. The individual must be able to work indoors in shafts or wells and outdoors in direct sunlight and dust, possess unimpaired balance,

Table 1. Job demand

Aspect	Job demand (brief)	Current condition	Tool / Test used	Fit / Suitability
Physical Capacity	Must sustain heavylifting, repetitive motions, prolonged upright posture, and wholebody vibration; requires a minimum of 7,9 METs for safe performance.	4.37 METs (SixMinute Walk Test) – below the required threshold.	SixMinute Walk Test	Not suitable
Motoric skill	Strong grip, full flexionand extension of all joints, and precise handand wrist coordination to operate drilling equipment.	Optimal muscle strength in all extremities	Motoric examination	Suitable
Organization	Effective communication and teamwork; able to convey instructions and safety information clearly within the mining crew.	Good communication; no reported obstacles.	History & interview	Suitable
Ergonomic	Able to stand for long periods, perform forcegrip tasks, repeat handwrist motions, squat, and walk moderate distances.	Capable; no ergonomic issues reported.	Observation, history	Suitable
Eye / Visual	Nearvision at Jaeger ≤ J2 and a full visual field for safety checks in dimly lit tunnels.	Corrected near vision present,	Visual acuity, Humphrey Visual Field test	Suitable
Mental	Emotionally stable, free of severe disorders.	Emotionally stable; no cognitive or mental disorders identified.	Interview, screening (NBJSQ, SRQ20)	Suitable

and have no cognitive or mental behavioral disorders. Ergonomic endurance is required for extended standing, repetitive hand-wrist motions, forceful gripping of tools, and continuous use of personal protective equipment. Effective communication and teamwork are also vital.

Third, Medical status - He has been experiencing progressive dyspnea for one month, along with nocturnal sweating, a cough that has produced sputum occasionally for four months, and unintended weight loss. He discloses a previous diagnosis of pulmonary tuberculosis, for which medication-induced weakness led to the termination of treatment. On physical examination, the patient has bilateral rhonchi, tachypnea, and undernutrition. His oxygen saturation level is 94% on 4 L/min O_2. Serial chest radiographs show fluctuating infiltrates, and bronchoscopy confirms the presence of nonspecific interstitial pneumonia with a honeycomb pattern in the lower lobes, as seen on high-resolution chest computed tomography. Rifampicin-intermediate resistant Mycobacterium tuberculosis is identified. Iron (1.79 mg/L), copper (0.411 mg/L), and zinc (0.203 mg/L) concentrations are significantly higher than reference limits, according to bronchoalveolar lavage (BAL) fluid mineral analysis, while silica concentrations are below detection. A diagnosis of occupational pneumoconiosis with superimposed infectious processes is supported by the combined clinical, radiologic, microbiologic, and mineral findings.

Fourth, disability status – The patient shows a significant decrease in ventilatory reserve and exercise capacity, mainly due to interstitial lung disease combined with lingering effects of previous tuberculosis. He reports early fatigue during moderate activities and cannot sustain heavy lifting or long walks without supplemental oxygen. There is no sign of neurological or visual problems, indicating the respiratory system is the main source of his functional limitations. As a result, these lung impairments directly affect his stamina and ability to handle the physically demanding tasks of his mining job.

Fifth, Risk Evaluation – In high-risk occupational environments, a worker with compromised respiratory function has a higher risk of experiencing acute hypoxic events, especially during physically demanding tasks. This not only endangers the individual but also poses risks to colleagues. If medical intervention is needed, the presence of multidrug-resistant pathogens greatly increases concerns about nosocomial infections. Additionally, impaired performance due to respiratory limitations raises the likelihood of operational errors, which can undermine overall workplace safety.

Sixth, Tolerance – Mr. M's colleagues and supervisors have shown willingness to provide accommodations for his health condition. After a comprehensive evaluation using the PERDOKI seven-step assessment, Mr. M is currently considered temporarily unfit for mining duties. To support his recovery and enhance his overall quality of life, participation in a structured pulmonary rehabilitation program is strongly recommended.

Besides the several components of the returntowork assessment, the prognosis of the disease must also be evaluated to make an accurate decision about resuming work. We based our approach on two evidencebased articles. Hall et al. reported that miners with pneumoconiosis who receive early jobtransfer and regular pulmonary surveillance experience markedly lower rates of disease progression and better functional outcomes. [7] A systematic review by Jamshidi et al. Silicosis and silica dust exposure increase the risk of tuberculosis and demonstrated that coexistent silicotuberculosis considerably worsens respiratory prognosis.[8]

Our patient is a 38yearold male tin miner who presented with a 1 month history of cough, dyspnea, and radiographic findings consistent with pneumoconiosis, together with microbiologically confirmed pulmonary tuberculosis. The patient did not meet the MET threshold and required prolonged antiTB treatment, he was classified as temporarily unfit for mining work. The overall prognosis was considered moderate: the pneumoconiosis component remains stable, but tuberculosis adds uncertainty. Consequently, a graded, monitored returntowork plan is recommended, comprising:

- Completion of the intensive phase of TB therapy before any dustexposed duties.
- Assignment to lowdust, lowintensity tasks (e.g., equipment maintenance) until a MET ≥ 7.0 is consistently achieved on exercise testing.
- Quarterly pulmonary function testing and chest imaging for the first year.

These recommendations are in line with the evidence that early medical intervention and job modification improve functional outcomes for miners with combined pneumoconiosisTB disease.

Conclusion

Using the PERDOKI seven-step assessment, the evaluation of a traditional tin miner diagnosed with both tuberculosis and pneumoconiosis determined that the worker is presently unfit for duty. While the individual's baseline musculoskeletal strength, cognitive function, and fundamental job skills appear relatively preserved despite active pulmonary infection and permanent lung fibrosis, the presence of these respiratory conditions precludes immediate return to mining activities. Improvement is possible with appropriate medical intervention and a phased rehabilitation program.

A thorough occupational medicine strategy is necessary. This should involve modifying the work environment, applying exposure reduction techniques, coordinating multidisciplinary care, and maintaining ongoing health monitoring. These actions are crucial to prevent disease progression and occupational relapse, ensuring any future return to work is both safe and successful.

Recommendation

To improve respiratory function and support recovery, it is crucial that Mr. M, who has a history of traditional tin mining and currently suffers from both active tuberculosis and pneumoconiosis, participates in a comprehensive physiotherapy program. Consistent participation in structured physiotherapy can enhance his chances of pulmonary rehabilitation. Before considering his return to factory work, enough time should be given for therapeutic progress and a thorough reassessment of his functional capacity.

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