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Original Research

Preventive Management for Occupational Diseases in Battery Industry

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Abstract—*Occupational diseases are an important topic since they often occur over a long time. The purpose of this article is to find out how to prevent occupational diseases in the battery industry. This research is a systematic review of articles obtained through manual search engines from Google Scholars, Proquest, PubMed, Research Gate and has been published nationally and internationally in 2015-2020. The results of a systematic review were obtained from 30 scientific articles that were published nationally and internationally in 2015-2020 related to the battery industry process and related to occupational diseases. The factors contributing are varies from environmental, biological, ergonomic, and the workers themselves. There are several preventive management that can be done according to the analysis of the possible diseases that can be occurred. Workers in the battery industry can experience occupational diseases, including allergic contact dermatitis, bacterial conjunctivitis, noise-induced hearing loss, Low Back Pain, and Carpal tunnel syndrome. Some prevention efforts that can be done include: using personal protective equipment, detecting workers who have a history of DKA, maintaining hygiene and cleanliness of the work environment, using furniture that is in accordance with ergonomic standards and not lifting heavy loads, reducing repetitive pressing movements and doing regular exercise.*

Keywords: *preventive, allergic contact dermatitis, conjunctivitis, NIHL, LBP, CTS, battery industry*

Abstrak—Penyakit akibat kerja menjadi perhatian penting karena muncul dalam jangka waktu panjang sehingga harus dilakukan upaya pencegahan penyakit. Penelitian ini merupakan review sistematik artikel yang diperoleh melalui melalui mesin pencari manual dari Google Scholars, Proquest, PubMed, Research Gate dan telah terpublikasi nasional maupun internasional pada tahun 2015-2020. Hasil review sistematik diperoleh dari 30 artikel ilmiah yang telah terpublikasi nasional maupun internasional pada tahun 2015-2020 yang terkait dengan proses industry baterai dan terkait dengan penyakit akibat kerja. Faktor penyebabnya juga berbagai macam karena faktor lingkungan, biologi, ergonomi, ataupun dari faktor pekerja. terdapat beberapa upaya preventif yang dapat disesuaikan dengan kemungkinan penyakit akibat kerja yang mungkin akan timbul. Pekerja di industri baterai dapat mengalami penyakit akibat kerja, antara lain: dermatitis kontak alergi, konjungtivitis bakteri, gangguan pendengaran akibat kebisingan, Low Back Pain dan Carpal tunnel syndrome. Beberapa upaya pencegahan yang dapat dilakukan antara lain: menggunakan alat pelindung diri, mendeteksi pekerja yang memiliki riwayat DKA, menjaga kebersihan dan kebersihan lingkungan kerja, menggunakan furnitur yang sesuai dengan standar ergonomis dan tidak mengangkat beban berat, mengurangi penekanan berulang. gerakan dan melakukan olahraga teratur.

Kata Kunci: *preventif, dermatitis kontak alergi (dka), konjungtivitis, NIHL, LBP, CTS, industri baterai*

BACKGROUND

Indonesia is one of the countries in the nickel-based industry in the world. Indonesia is a nickel-rich country with mining activities in several provinces like South Sulawesi, Central Sulawesi, Southeast Sulawesi, and North Maluku. It has lasted for a very long time since Indonesia is colonized by the Dutch and Japanese. Indonesia already has several nickel-based battery industries and planned to build a lithium-based battery industry (Sangadji, 2020).

The mining industry cannot be separated from occupational safety and health issues. Occupational health and safety issues in Indonesia are remaining overlooked. This statement is

supported by the high number of work accidents. In 2014 there were 40.694 occupational diseases cases in Indonesia (Husaini, 2017).

Workers' safety is related to engines, aircraft, work tools, materials, their processing process, workplaces, environment, and their ways to do the jobs. Occupational health is described as a physical, mental, and social condition of a person who does not only have no illness but also can interact with the environment and their works (Redjeki, 2016).

Occupational health is closely related to Occupational Diseases, which can be interpreted as diseases caused by work or the work environment (Permanaker number Per.01/Men/1981) which causes partial or total disability. Partial disability is failure or loss of the workforce for a while, while total disability is a condition that caused the workers is not able to work again. Most factors that cause OD is come from the workers themselves, whether it's neglectness or carelessness. The other factors that cause OD are safety regulation disobeyed nature factors, and equipment used. Occupational diseases now becoming an important concern because usually they occur after a long time. Usually, the workers ignore the work-risks and thus make the occupational disease arise. (Patradhiani, 2019). Disease prevention (5 levels) in occupational diseases, namely: Health promotion., specific protection, Early diagnosis and detection, prompt treatment and limitation of weak points, disability limitation, and rehabilitation (Sari, 2017).

The purpose of this article is to find out how to prevent occupational diseases in the battery industry.

METHODS

This study uses a systematic review model by conducting a study of several scientific articles that have been published nationally and internationally in 2015-2020. Reference sources through manual search engines from Google Scholars, Proquest, PubMed, Research Gate.

National journals are scientific publications written following scientific principles and scientific ethics; have ISSN; have an online version of the publication; aims to accommodate/communicate the results of scientific research and or scientific concepts in certain disciplines; published by publishers/ scientific bodies/ professional organizations/ scientific organizations/ universities with their units; use Indonesian and or English; and if it is accredited, it will get recognition or accreditation by the Ministry of Research, Technology and Higher Education.

Meanwhile, what is meant by international journals are scientific publications that are published regularly in the form of articles that disseminate scientific developments that are officially published with ISSN; written using the official UN languages (Arabic, English, French, Russian, Spanish, and Chinese) and/or indexed by international databases (Web of Science, Scopus, Microsoft Academic Search, and/or pages under the considerations of the Directorate General of Higher Education of the Republic of Indonesia).

Some of the inclusion criteria that have been used are as follows:

- Health research or related articles published in national and international journals in 2015-2020.
- Article research that discuss about health risks and preventive management in battery industry.

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RESULT AND DISCUSSION

Based on the results of a systematic review obtained from 30 scientific articles that have been published nationally and internationally in 2015-2020 related to the battery industry process and related to occupational diseases. Occupational diseases that can be occurred in battery industrial companies and preventive management are as follows:

Allergic Contact Dermatitis

Allergies experienced are caused by contact with specific exogenous allergens and are referred to as Allergic Contact Dermatitis (DKA), which is an adverse skin inflammatory reaction (Milam et al, 2019). Dermatitis can be defined as an inflammatory reaction characterized by consecutive and continuous erythema, blisters, exudation, papules, and peeling (Brans et al, 2018) Repeated contact on areas that are often exposed to direct allergen exposure will make it a chronic disease characterized by erythematous lichenification, plaques with hyperkeratosis, fissures, and pigmentation that can spread to areas that are often exposed so that itching and swelling are the keywords in this disease (Kostner et al, 2017).

The incidence of occupational dermatitis is per 1000 workers per year where about 0.5 to 1.9% of cases occur in European countries. In occupational contact dermatitis, the most common allergens are rubber, nickel, and latex. A person can experience DKA also depending on the type of work done by examining exposure to risk factors (Ahlstrom, 2019).

Workers in the battery industry tend to come into contact with chemicals from the battery manufacturing process such as nickel (Ni) or lead (Pb). These materials can cause allergies on the skin so that it can cause allergic contact dermatitis (Shakik et al, 2019).

Several preventive measures that can be taken to prevent DKA are (1) Limiting exposure by performing protection such as using personal protective equipment (PPE), namely using gloves when working so as not to have direct contact with allergens such as nickel; (2) Perform patch test checks on workers who will be placed in work units that require contact with metals that can cause allergic contact dermatitis; (3) Identify workers who have experienced DKA or who are vulnerable so that they are not placed in parts of the work unit that require contact with allergens; and (4) Implementing personal hygiene by washing hands properly, and supporting adequate sanitation facilities in the workplace (providing handwashing facilities, soap) (Iter & Johansen, 2019).

Prevention of DKA can be done by using personal protective equipment such as the use of gloves which will prevent material exposure to workers' skin or the use of automatic tools that will cut off the contact of production materials with workers, but this is not easy to do because it requires not cheap costs and can reduce worker.

Bacterial Conjunctivitis

Acute bacterial conjunctivitis can be experienced by workers in the battery industry which is usually a mild case and can heal itself, lasting for 10-14 days. Germs that are often the cause are S. pneumonia, S. aureus, H. influenza, and Moraxella catarrhalis (Lisa & Hire, 2020). Clinical signs of bacterial conjunctivitis may include bilateral hyperemia, purulent exudate with the eyelids sticking together upon awakening, and sometimes eyelid edema. The infection initially occurs in one eye and is transmitted through the hands to the other eye or transmitted to others through objects that can spread germs (Micah & Jacqueline, 2020). In most cases of bacterial conjunctivitis, the causative organism can be identified by microscopic examination

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of conjunctival scrapings or ocular fluid by smearing with Gram or Giemsa stains. This examination will show many polymorphonuclear neutrophils (Ryder & Benson, 2020).

Battery industry workers tend to come into contact with chemicals in the manufacture of batteries, one of which is lead. The lead dust particles can carry pathogenic microorganisms, and if they stick to the eyes of workers, they can cause eye diseases, one of which is bacterial conjunctivitis (Elsir & Alrasheed, 2018).

Preventive efforts that can be done are (1) Using personal protective equipment (PPE), namely gloves and protective glasses when working so as not to have direct contact with microorganisms; (2) Implement personal hygiene by washing hands properly, and supporting adequate sanitation facilities (providing handwashing places, soap, clean toilets and in sufficient quantities); (3) Do not share handkerchiefs or towels with other people; (4) Do not rub your eyes with your hands; and (5) Identify workers who have bacterial conjunctivitis so that therapy is immediately carried out so that they do not infect other workers (Ahmed & Hamdan, 2016).

Noise-Induced Hearing Loss (NIHL)

Noise-induced hearing loss (NIHL) is a cochlear sensorineural hearing loss resulting from long-term noise exposure and generally occurs in both ears. Noise is an unwanted sound where noise exposure can occur in the work environment. The organ that is often damaged is the Corti apparatus for sound receptors with a frequency of 3000 Hz to 6000 Hz and the heaviest damage to sound receptors with a frequency of 4000 Hz (Mayasari & Khairunnisa, 2017; Ding T dkk, 2019).

NIHL is the second most common cause of deafness after presbycusis in many countries (Ding T et al, 2019). WHO in 2017 estimated 360 million people worldwide suffer from severe deafness and 1.1 million young people aged 12 to 35 years experience deafness due to noise (WHO, 2017). NIHL is an irreversible disorder because curative therapy is less effective in overcoming it, so preventive action is the best option (Chen et al, 2020).

Preventive measures that can be taken are (1) Identifying sources of noise in the workplace; (2) Conduct noise analysis by measuring noise level; (3) using earplugs or ear muffs or a combination of both can reduce noise exposure by up to 20 dB (Brennan JCG et al, 2020); (4) Provide a duration limit for noise exposure under the Regulation of the Minister of Health of the Republic of Indonesia No. 70 of 2016 concerning Industrial Work Environment Health Standards and Requirements. Noise where the noise threshold value is 85 dB (Ding T et al, 2019); (5) Controlling noise sources by: replacing machines/production tools that produce low noise, replacing components of machines/production tools that produce low sounds, providing dampers for sources of vibration that produce high noise, performing regular maintenance on machines/production equipment, placing machines with high noise levels to other locations (Brennan JCG et al, 2020) (Chen et al, 2020); and (6) Perform early detection before permanent hearing loss occurs with a routine schedule of audiometric tests (Mirza R et al, 2018).

Low Back Pain

Low Back Pain (LBP) is a condition with discomfort or acute pain in the lumbar and sarcal area. LBP is a disease that is mostly experienced by workers or known as Work-Related Low Back Pain. Work-Related Low Back Pain is a pain in the work context and clinically may be caused by work or can be exacerbated by work activities (Wahab, 2019).

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Low Back pain consists of three different types of pain, including lumbosacral pain, radicular pain, and radiating pain. Back lumbosacral pain refers to pain in the lumbar region or L1-5 and sacral or S1-sacrococcygeal vertebrae. Radicular pain to the extremities along with the distribution of the dermatome due to irritation of the nerve ganglion. Pain that radiates, spreads to the regions along the non-dermatomal pathway (Urits et al, 2019).

The prevalence of LBP worldwide in 2019 reached 577 million cases. In Indonesia in 2018, the prevalence of musculoskeletal diseases in Indonesia was 7.3%. However, the exact data for LBP is still not known (Mattiuzzi et al, 2020).

The battery industry usually requires working standing, bending, and lifting heavy loads continuously. This can place a large mechanical load on muscles, tendons, ligaments, and joints. Heavy loads will cause irritation, inflammation, muscle fatigue, damage to muscles, tendons, and other tissues. This is a risk factor for LBP (Andini, 2015).

The complaints that often arise in industrial workers are back pain, neck pain, and pain in the wrists, elbows, and feet. There are several risk factors for musculoskeletal disorders, including repetitive work, work duration, vibration, inappropriate, boring, and painful situations, moving heavy equipment, lifting heavy objects, standing for a long time, and walking long distances (Yang et al., 2016).

Preventive measures that can be taken to prevent LBP from occurring in battery industry workers include 1) Not lifting too heavy a load, if necessary, using a tool to lift objects, especially when at work; 2) using furniture following ergonomic standards; 3) maintaining diet; 4) avoiding smoking, and 5) exercise regularly 3-5 days a week. Exercising such as aerobic exercise, muscle strength training, flexibility, or coordination training (Maher, 2017).

Carpal Tunnel Syndrome

Carpal tunnel syndrome (CTS) is a symptom of compression neuropathy of the median nerve at the wrist, characterized by increased pressure in the carpal tunnel and decreased nerve function. The most common complaints are pain, numbness, and tingling along with the distribution of the median nerve (Padua et al, 2016).

According to the International Labor Organization (ILO), work-related musculoskeletal disorders are numerous, with around 160 million work-related illnesses occurring every year in the world. (Parno et al., 2017). The incidence of CTS is 7.5 cases per 100 population/year (Cardona et al., 2019). The prevalence of carpal tunnel syndrome (CTS) in women is 3 times greater (0.7-9.2%) than men (0.4-2.1%) and is highest in women aged 45-54 years. Typical symptoms are pain and sensory disturbances at night along with the distribution of the median nerve, namely the thumb, index finger, and middle finger, but sometimes it can occur in all fingers. Risk factors that influence CTS include diabetes mellitus, menopause, hypothyroidism, obesity, arthritis, and pregnancy (Padua et al, 2016).

CTS from the compression and traction mechanism. Elements of pressure include increased pressure, obstruction of overall venous outflow, increased local edema, and impaired intraneural microcirculation of the median nerve. There is a disturbance of nerve dysfunction and structural integrity of nerves which then increases environmental dysfunction. There is a lesion of the myelin sheath and axons and inflammation of the surrounding connective tissue. The myelin sheath and axons develop lesions and the surrounding connective tissue becomes inflamed. Repetitive wrist traction and movement can exacerbate

lesions on the nerves. In addition, one of the nine flexor tendons that run through the carpal tunnel can become inflamed and press on the median nerve (Sevy & Varacello, 2020).

Workers in the battery assembly section tend to work in an awkward position, repetitive hand movements with a high enough sense of tension. This can cause musculoskeletal disorders, one of which is carpal tunnel syndrome (Prasad & Dhamale, 2018).

Preventive measures that can be taken to prevent the occurrence of CTS include: 1) Adjusting the height of the workbench or equipment in the workplace; 2) moving the hands and wrists without excessive tension; 3) exercise, such as stretching and bending the wrist, after performing a task that requires repetitive motion can reduce the negative effects of the task; and 4) keeping muscles warm makes muscles less likely to hurt, so it is important to keep your hands warm while working, one of which is wearing gloves (Tsilidi et al, 2018).

CONCLUSION

Workers in the battery industry can experience occupational diseases, including allergic contact dermatitis, bacterial conjunctivitis, noise-induced hearing loss, Low Back Pain, and Carpal tunnel syndrome.

Some prevention efforts that can be done include: using personal protective equipment, detecting workers who have a history of DKA, maintaining hygiene and cleanliness of the work environment, using furniture that is following ergonomic standards and not lifting heavy loads, reducing repetitive pressing movements and doing regular exercise.

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