



Occupational disease control through periodic medical check-up programs in the sugar processing industry

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ARTICLE INFO

Keywords:

Disease control,
Industrial workers,
Medical check-up,
Occupational disease,
Occupational health
surveillance.

ABSTRACT

Occupational diseases and work-related health problems remain important challenges in industrial workplaces, particularly in the sugar processing industry, where workers may be exposed to physical, chemical, ergonomic, and psychosocial risk factors. This study aimed to analyze the role of periodic Medical Check-Up programs in supporting occupational disease control among industrial workers. A descriptive qualitative approach was used through field observation and interviews related to the implementation of Medical Check-Up programs at PT X Lampung. The program is conducted annually for all employees and includes health history assessment, vital signs examination, anthropometric measurement, physical examination, laboratory tests, urinalysis, thorax X-ray, electrocardiography, spirometry, audiometry, eye examination, heat stress assessment, and fitness-for-work evaluation. The findings show that the Medical Check-Up program supports early detection of occupational diseases and non-communicable disease risk factors, including hypertension, obesity, diabetes mellitus, dyslipidemia, respiratory impairment, hearing loss, and cardiovascular disorders. Follow-up mechanisms are provided through the company clinic, external healthcare facilities, hospital referrals, health insurance services, and health education. The results indicate that periodic Medical Check-Up programs can serve as an important preventive strategy in occupational health surveillance, worker health protection, and workplace risk management. Continuous improvement is needed through risk-based examination planning, systematic documentation, medical follow-up monitoring, and the use of aggregated health data to support workplace health interventions.

1. Introduction

Occupational health is an essential component of worker protection and industrial productivity. In manufacturing industries, workers are continuously exposed to various occupational risk factors that may affect their physical and

mental health. These risks may arise from physical, chemical, biological, ergonomic, and psychosocial hazards in the workplace. If not properly monitored and controlled, such exposures may contribute to occupational diseases, work-related health problems, reduced work capacity, increased absenteeism, and decreased productivity [1, 2].

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<https://doi.org/10.55749/jnms.v1i1.203>

Received 1 January 2026; Received in revised form 1 February 2026; Accepted 10 March 2026

Available online 30 June 2026

XXXX-XXXX/Published by [Indonesian Scholar Society](https://journal.solusiriset.com/index.php/jnms).

The sugar processing industry is one of the industrial sectors with diverse occupational health risks. Production activities in this industry commonly involve high-temperature work areas, dust exposure, machine noise, chemical use, repetitive work, and heavy physical workloads. Workers exposed to these conditions may experience respiratory disorders, hearing impairment, heat-related illness, musculoskeletal complaints, cardiovascular problems, and other health disturbances. In addition to occupational diseases, industrial workers may also experience non-communicable disease risk factors such as hypertension, obesity, diabetes mellitus, dyslipidemia, and cardiovascular disorders, which can further reduce work performance and increase the risk of workplace accidents [3–5].

Medical Check-Up programs are an important part of occupational health surveillance and disease prevention in the workplace. Periodic health examinations allow companies to detect early signs of occupational diseases and general health problems among workers. Through health history assessment, physical examination, laboratory tests, lung function tests, hearing tests, electrocardiography, radiological examination, and fitness-for-work evaluation, companies can obtain important information about the health status of their workforce. The results of Medical Check-Up programs can also be used to determine whether workers are fit for their current job, require medical follow-up, or need workplace adjustments based on their health condition [6, 7].

In Indonesia, the implementation of worker health examinations is supported by occupational safety and health regulations, including Law Number 1 of 1970 concerning Occupational Safety and the Regulation of the Minister of Manpower and Transmigration Number Per.02/Men/1980 concerning Health Examination of Workers in the Implementation of Occupational Safety. These regulations emphasize the responsibility of employers to protect worker health and conduct health examinations as part of occupational safety and health management. Therefore, Medical Check-Up programs should not only be considered routine administrative activities but also preventive strategies for occupational disease control and worker health protection [8–10].

At PT X Lampung, periodic Medical Check-Up programs are implemented annually for all employees as part of the company's Occupational Health and Safety program. The program is supported by collaboration with external healthcare facilities, the company's internal clinic, medical referral mechanisms, health insurance services, and health education activities. In addition, the company evaluates the relationship between workers' health examination results and occupational risk factors to support disease control and workplace health management [3, 11].

However, the effectiveness of Medical Check-Up programs depends not only on the implementation of examinations but also on follow-up actions, documentation, health education, referral systems, and the use of aggregated health data for workplace intervention. Risk-based health surveillance is also important because workers with different job exposures may require different types of medical examinations. For example, workers exposed to dust may require spirometry and thorax examination, workers exposed to noise may require audiometry, and workers exposed to heat may require hydration and heat stress assessment.

Based on this background, this study aims to analyze occupational disease control through periodic Medical Check-Up programs in the sugar processing industry. The study focuses on the implementation of Medical Check-Up programs, the types of examinations conducted, follow-up mechanisms for abnormal findings, the role of internal and external healthcare facilities, and the contribution of periodic health examinations to worker health protection and occupational disease prevention.

2. Materials and Methods

2.1. Study design and location

This study used a descriptive qualitative approach to analyze occupational disease control through periodic Medical Check-Up programs in the sugar processing industry. This approach was selected because the study focused on describing the implementation, workflow, follow-up mechanisms, and role of Medical Check-Up programs in supporting occupational health surveillance and worker health protection [12, 13].

The study was conducted at PT X Lampung, a sugar processing company in Lampung, Indonesia. This location was selected because the sugar processing industry involves various occupational health risk factors, including dust exposure, heat stress, noise, chemical exposure, physical workload, and ergonomic risks. These risk factors may contribute to occupational diseases and work-related health problems among workers.

2.2. Data collection

Data were collected through field observation and interviews related to the implementation of Medical Check-Up programs at the company. Field observations were conducted to understand the general implementation of occupational health programs, the role of the company clinic, and the follow-up process for workers with abnormal examination results.

Interviews were conducted to obtain information regarding the Medical Check-Up program workflow, the frequency of health examinations, types of examinations provided, collaboration with external healthcare facilities, referral mechanisms, use of company health insurance, and health education activities. The study also reviewed general information related to the types of Medical Check-Up examinations conducted as part of the company's Occupational Health and Safety program.

2.3. Medical check-up program assessment

The Medical Check-Up program was assessed based on several components, including program implementation, examination types, follow-up procedures, and the use of examination results for occupational disease control. The assessed examination components included anamnesis or health history, vital signs examination, anthropometric measurement, general physical examination, laboratory tests, urinalysis, thorax X-ray, electrocardiography, spirometry, audiometry, eye examination, heat stress assessment, fitness-for-work evaluation, pre-employment examination, periodic examination, special examination, and return-to-work examination.

These examination components were analyzed to determine their role in detecting occupational diseases and non-communicable disease risk factors, such as hypertension, obesity, diabetes mellitus, dyslipidemia, respiratory impairment, hearing loss, cardiovascular disorders, and heat-related health risks.

2.4. Occupational health surveillance analysis

The analysis was conducted by examining how Medical Check-Up results were used as part of occupational health surveillance. The study focused on whether periodic health examinations supported early detection, follow-up treatment, referral to healthcare facilities, health education, and workplace risk evaluation. The follow-up system was analyzed based on the company's procedures for workers with abnormal examination results. These included referral to hospitals, use of BPJS and In Health insurance facilities, consultation at the company clinic, and health education provided by physicians from hospitals or the

company clinic. The role of the internal clinic was also assessed in relation to daily health monitoring, basic healthcare services, blood pressure checks, and preventive health education.

2.5. Data analysis

The collected data were analyzed descriptively. The analysis was conducted by organizing information from field observations and interviews into several main themes: implementation of the Medical Check-Up program, types of examinations conducted, follow-up mechanisms, role of internal and external healthcare facilities, occupational and non-communicable disease risk factors, and the contribution of Medical Check-Up programs to occupational disease control.

The analysis also considered the relationship between workers' health examination results and workplace risk factors. This was important to determine whether abnormal findings were potentially related to occupational exposure or general health conditions. The results were interpreted to evaluate the role of periodic Medical Check-Up programs in supporting worker health protection, early disease detection, workplace health intervention, and productivity maintenance.

This study did not disclose individual medical data or personally identifiable health information of workers. The analysis focused on the implementation and management of the Medical Check-Up program, follow-up mechanisms, and general occupational health surveillance practices. Confidentiality of worker health information was maintained by using general and descriptive information only.

3. Results and discussion

3.1. Implementation of periodic medical check-up programs

The results showed that PT X Lampung has implemented a periodic Medical Check-Up program as part of its Occupational Health and Safety management system. The program is conducted annually and provided to all employees without differentiating job types or departments. This indicates that the company applies a broad preventive health surveillance approach to monitor the general health status of its workforce [6, 14, 15].

The annual Medical Check-Up program is implemented in collaboration with external healthcare facilities, particularly appointed hospitals, while the company's internal clinic plays an important role in daily health monitoring, basic health services, blood pressure checks, health education, and follow-up support. This collaboration allows the company to conduct more comprehensive examinations using adequate diagnostic facilities while maintaining continuous health monitoring through the internal clinic [4, 16]. The implementation of periodic health examinations is important because workers in the sugar processing industry may be exposed to several occupational health risk factors, including heat stress, dust exposure, noise, chemical exposure, physical workload, and ergonomic hazards. These exposures may contribute to occupational diseases and work-related health problems if they are not properly monitored and controlled. Therefore, the Medical Check-Up program serves as an important preventive strategy for early detection, follow-up care, and occupational disease control [17, 18].

3.2. Types of medical check-up examinations

The Medical Check-Up program at PT X Lampung includes general health examinations, diagnostic tests, and specific occupational health assessments. These examinations are designed to identify general health conditions, detect non-communicable disease risk factors, assess organ function, and evaluate possible occupational health problems related to workplace exposures [3, 6, 16]. The summary of Medical Check-Up examination components is presented in Table 1.

The table shows that the Medical Check-Up program covers both general health assessment and occupational health surveillance. General examinations, such as vital signs, anthropometry, physical examination, blood tests, and urine tests, are useful for detecting non-communicable disease risk factors. Meanwhile, specific examinations such as spirometry, audiometry, thorax X-ray, heat stress assessment, and fitness-for-work evaluation are more closely related to occupational risk factors in the industrial work environment [24].

Table 1
Types of medical check-up examinations and their objectives

No	Type of Examination	Examination Components	Objective
1	Health history assessment	Medical history, occupational history, family history, lifestyle, and health complaints	To identify baseline health status and individual risk factors
2	Vital signs examination	Blood pressure, pulse, body temperature, and respiration	To assess general health stability
3	Anthropometric examination	Height, weight, and Body Mass Index	To assess nutritional status and obesity risk
4	General physical examination	Examination of head, eyes, ears, heart, lungs, abdomen, and extremities	To detect physical abnormalities and general health problems
5	Blood laboratory test	Hemoglobin, blood glucose, cholesterol, uric acid, liver function, and kidney function	To detect metabolic disorders and organ function abnormalities
6	Urine test	Urinalysis, urine protein, and urine glucose	To assess kidney function, hydration status, and metabolic abnormalities
7	Thorax X-ray	Chest radiographic examination	To evaluate lung and thoracic conditions
8	Electrocardiography	Heart rhythm and electrical activity examination	To detect cardiac rhythm disorders and cardiovascular abnormalities
9	Spirometry	Lung function test	To assess lung capacity and detect respiratory impairment
10	Audiometry	Hearing function test	To detect noise-induced hearing loss
11	Eye examination	Visual acuity and color blindness assessment	To assess visual function and support work safety
12	Heat stress assessment	Hydration status, electrolyte balance, and body temperature	To detect risk of dehydration and heat-related disorders
13	Fitness-for-work evaluation	Physical fitness and work capacity assessment	To determine worker suitability for assigned tasks
14	Pre-employment Medical Check-Up	Baseline health screening for job applicants	To determine initial fitness for work
15	Periodic Medical Check-Up	Routine annual health screening	To monitor worker health periodically
16	Special Medical Check-Up	Risk-based examination according to specific occupational exposure	To detect occupational diseases related to workplace hazards
17	Return-to-work Medical Check-Up	Examination after prolonged illness or leave	To assess readiness to return to work

3.3. Early detection of occupational and non-communicable diseases

The implementation of Medical Check-Up programs supports the early detection of occupational diseases and non-communicable disease risk factors among workers. In industrial settings, occupational diseases may develop gradually due to repeated or long-term exposure to workplace hazards. For example, exposure to dust and airborne particles may contribute to respiratory disorders, while prolonged exposure to noise may result in hearing impairment. Workers exposed to heat may also experience dehydration, heat exhaustion, and reduced work performance [14, 22, 23].

In addition to occupational diseases, the Medical Check-Up program is also important for detecting non-communicable diseases such as hypertension, obesity, diabetes mellitus, dyslipidemia, cardiovascular disorders, and organ function abnormalities. These conditions may not always be directly caused by workplace exposure, but they can influence worker fitness, productivity, concentration, and safety during work. For example, uncontrolled hypertension may increase the risk of cardiovascular events, while diabetes mellitus may affect vision, nerve function, and wound healing. Obesity may reduce physical work capacity and increase the risk of musculoskeletal complaints.

Blood pressure measurement is one of the most important components of the Medical Check-Up because hypertension is commonly found among productive-age workers. High blood pressure may be influenced by work stress, physical workload, unhealthy diet, smoking, lack of exercise, irregular sleep patterns, and age. In high-risk

industrial work, hypertension can reduce concentration and increase the risk of accidents, especially among machine operators and field workers.

Anthropometric examination is also essential because Body Mass Index can indicate overweight or obesity. Obesity is associated with an increased risk of diabetes mellitus, hypertension, dyslipidemia, cardiovascular disease, sleep apnea, and musculoskeletal disorders. In the workplace, obesity can reduce mobility, increase fatigue, and lower work capacity.

Laboratory examinations provide important information about metabolic and organ health. Blood glucose testing can detect diabetes mellitus or prediabetes, while cholesterol and triglyceride examinations can identify cardiovascular risk factors. Liver and kidney function tests are also relevant, especially for workers who may be exposed to chemicals or have other health risks. Urine analysis supports the assessment of kidney function, metabolic abnormalities, and hydration status.

3.4. Occupational exposure-specific examinations

Specific examinations in the Medical Check-Up program are important for workers exposed to certain occupational hazards. Spirometry is useful for evaluating lung function among workers exposed to dust, smoke, gas, or chemical substances. Abnormal spirometry results may indicate obstructive or restrictive lung disorders, which can reduce activity tolerance and work capacity. Audiometry is important for detecting noise-induced hearing loss. In industrial workplaces, continuous exposure to high noise levels can cause gradual and permanent hearing impairment. Hearing loss may affect communication, reduce situational awareness, and increase the risk of operational errors or workplace accidents [20, 21, 25].

Thorax X-ray examination helps evaluate lung and thoracic conditions, especially among workers exposed to dust or smoke. This examination can support the detection of lung infections, pulmonary abnormalities, or other conditions that may affect work capacity. Electrocardiography is useful for identifying cardiac rhythm abnormalities, signs of ischemia, or other cardiovascular problems. This examination is particularly important for older workers or workers with cardiovascular risk factors, because cardiac disorders can increase the risk of sudden health events in the workplace. Heat stress assessment is also relevant in the sugar processing industry because some work areas may involve high-temperature exposure. Evaluation of hydration status, electrolyte balance, and body temperature can help detect workers at risk of dehydration or heat-related illness. Preventive actions such as adequate drinking water, rest periods, ventilation, and health education are necessary to reduce heat stress risks.

3.5. Follow-up mechanisms for abnormal findings

The findings indicate that workers with normal Medical Check-Up results do not require specific medical follow-up. However, workers with abnormal findings are advised to receive further management through available health service mechanisms. The company supports follow-up through BPJS and InHealth facilities, hospital referrals, consultation with company clinic doctors, and health education [16, 26, 27].

This follow-up mechanism is essential because the value of Medical Check-Up programs depends not only on conducting examinations but also on how abnormal findings are managed. Without proper follow-up, early detection may not lead to effective disease control. Therefore, referral systems, medical consultation, health education, and monitoring of worker conditions are important components of occupational health surveillance. Health education is also provided by hospital physicians and company clinic doctors. This activity supports promotive and preventive efforts by increasing worker awareness of disease prevention, healthy lifestyle, medication adherence, and occupational risk reduction. Health education is particularly important for workers with risk factors such as hypertension, obesity, abnormal blood glucose, dyslipidemia, or respiratory and hearing problems [14, 22, 23].

3.6. Role of the internal clinic and external healthcare facilities

The company's internal clinic plays an important role in supporting occupational health programs. The clinic provides daily health services, basic medical care, blood pressure checks, health education, and initial follow-up for workers with health complaints. This role is important

because the internal clinic functions as the first point of contact for workers who experience health problems during work [28, 29].

Meanwhile, external healthcare facilities support the implementation of annual Medical Check-Up programs by providing more comprehensive diagnostic examinations. Collaboration with hospitals allows the company to conduct laboratory tests, imaging examinations, electrocardiography, spirometry, audiometry, and other medical assessments more effectively. The combination of internal clinic services and external hospital collaboration creates a more integrated occupational health system. The internal clinic supports continuous monitoring, while external healthcare facilities provide comprehensive examination capacity. This integration is important for early detection, referral, treatment, and long-term health monitoring [19–21].

3.7. Medical check-up as an occupational health surveillance strategy

The Medical Check-Up program can be considered an important occupational health surveillance strategy. Through periodic examinations, the company can monitor worker health status, identify disease patterns, detect occupational health risks, and support workplace intervention planning. Aggregated Medical Check-Up results can be used to evaluate whether certain health problems are related to workplace conditions or general lifestyle factors [14, 22, 23].

For example, if many workers show reduced lung function, the company may need to evaluate dust exposure, ventilation systems, respiratory protection, and housekeeping practices. If audiometry results show hearing impairment among workers, the company should assess noise exposure, machine isolation, hearing protection compliance, and work duration. If heat-related findings are observed, the company should improve hydration programs, rest breaks, ventilation, and heat stress management. Therefore, Medical Check-Up results should not only be used for individual medical follow-up but also as a basis for workplace risk control. This approach allows the company to move from passive health screening to active occupational disease prevention.

3.8. Contribution to worker protection and productivity

Periodic Medical Check-Up programs contribute to worker health protection and productivity in several ways. First, early detection allows workers to receive medical treatment before diseases become more severe. Second, the program supports fitness-for-work decisions, ensuring that workers are assigned to tasks that match their health conditions and physical capacity. Third, the program helps reduce the risk of sudden illness, work accidents, absenteeism, and decreased performance.

Healthy workers are more likely to maintain concentration, physical endurance, and work efficiency. Conversely, undetected diseases such as hypertension, diabetes, respiratory impairment, hearing loss, or cardiovascular disorders may reduce work ability and increase accident risk. Therefore, Medical Check-Up programs are not only beneficial for workers but also support company productivity and business sustainability.

3.9. Areas requiring improvement

Although the Medical Check-Up program has been implemented annually and supported by follow-up mechanisms, several areas still need improvement. First, the company should strengthen risk-based Medical Check-Up planning. Workers with different occupational exposures should receive examinations according to their specific risks. For example, workers exposed to noise should receive regular audiometry, workers exposed to dust should receive spirometry and thorax evaluation, and workers exposed to heat should receive heat stress and hydration assessment.

Second, systematic documentation and analysis of aggregated Medical Check-Up data should be improved. Aggregated health data can help the company identify dominant health problems among workers and design targeted interventions. Third, follow-up monitoring should be strengthened to ensure that workers with abnormal results receive appropriate treatment and lifestyle modification support.

Fourth, health education programs should be conducted regularly and adjusted to the most common health problems identified from Medical Check-Up results. If hypertension, obesity, diabetes, or dyslipidemia are common findings, the company should provide targeted education on diet, physical activity, stress management, smoking cessation, and disease prevention.

Overall, the results suggest that periodic Medical Check-Up programs are important for occupational disease control, early detection of non-communicable diseases, worker health protection, and productivity maintenance. In the article, the MCU program is described as being conducted annually for all employees and supported by external healthcare facilities, the internal clinic, referral mechanisms, health insurance, and health education. However, its effectiveness can be further strengthened through risk-based examination planning, systematic data documentation, continuous follow-up, and the use of aggregated health data for workplace health intervention.

4. Conclusion

This study shows that periodic Medical Check-Up programs play an important role in supporting occupational disease control and worker health protection in the sugar processing industry. The annual Medical Check-Up program implemented at PT X Lampung provides a preventive health surveillance mechanism for detecting occupational diseases and non-communicable disease risk factors among workers. The examination components, including health history assessment, vital signs measurement, anthropometric examination, laboratory tests, urinalysis, thorax X-ray, electrocardiography, spirometry, audiometry, eye examination, heat stress assessment, and fitness-for-work evaluation, are useful for identifying health conditions that may affect worker safety, work capacity, and productivity.

The implementation of the Medical Check-Up program is supported by collaboration with external healthcare facilities, the company's internal clinic, referral mechanisms, company health insurance facilities, and health education activities. These follow-up mechanisms are essential to ensure that workers with abnormal findings receive appropriate medical attention, consultation, and preventive guidance. In addition, the use of Medical Check-Up results to evaluate the possible relationship between worker health conditions and workplace risk factors can strengthen occupational health management and support more targeted workplace interventions.

Overall, periodic Medical Check-Up programs can serve as an important strategy for early detection, disease prevention, fitness-for-work evaluation, and occupational health surveillance in industrial workplaces. However, the program should be continuously improved through risk-based examination planning, systematic documentation of aggregated health data, regular follow-up monitoring, and targeted health education based on dominant worker health problems. Strengthening these aspects will help improve worker health protection, reduce occupational disease risks, support productivity, and promote sustainable Occupational Health and Safety management in the sugar processing industry.

CRedit authorship contribution statement

Veronica Ela Rimawati: Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Ni Putu Wanda Berlianda:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Regina Titan Puri:** Investigation, Data curation, Formal analysis, Writing – original draft. **Rizqi Syahnakri:** Investigation, Data curation, Formal analysis. **Ruies Gapanza Antaraga:** Investigation, Data curation, Formal analysis. **Sarah Aulia Hafizhah:** Investigation, Data curation, Formal analysis. **Singka Rasian Carolin:** Investigation, Data curation, Formal analysis. **Surya Aditya:** Investigation, Data curation, Formal analysis. **Syakila Putri Andini:** Investigation, Data curation, Formal analysis. **Tasya Putri Yasmin:** Investigation, Data curation, Formal analysis, Writing – review & editing. **Wildan Khalillur Rahmat:** Investigation, Data curation, Formal analysis, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgment

The authors would like to express their sincere gratitude to PT X Lampung for providing the opportunity and support to conduct this study on occupational disease control through periodic Medical Check-Up programs. The authors also thank the company's internal clinic and collaborating healthcare facilities for their support in the implementation of worker health monitoring, medical referral, and health education activities. Appreciation is also extended to the Faculty of Medicine, Malahayati University, Bandar Lampung, for academic guidance and support during the preparation of this manuscript. The authors hope that this study can contribute to strengthening occupational health surveillance, worker health protection, and preventive disease control in industrial workplaces.

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