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Analysis of the Effectiveness of Annual Free Health Screening Programs on Reducing the Risk of Occupational Diseases in Urban Areas of Indonesia

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ABSTRACT

Occupational diseases remain a significant health issue in the industrial sector. According to the ILO, approximately 2.6 million deaths each year are caused by work-related diseases and accidents. Early detection and intervention through worker health screening are strategic steps to reduce the incidence of occupational diseases. However, the factors influencing the success of reducing occupational diseases remain under-researched. This study aims to identify factors associated with occupational diseases among workers using an analytical cross-sectional design. Data were collected from 258 industrial workers in Karawang Regency using a stratified random sampling method, and analyses were conducted using the chi-square test and logistic regression. A lower risk of occupational diseases was observed among respondents who participated in screening (OR=1.964; p=0.015), received quality screening services (OR=3.810; p=0.000), received early detection (OR=12.143; p=0.000), showed positive behavioral changes (OR=4.958; p=0.000), worked in large companies (OR=4.307; p=0.000), had good OSH knowledge (OR=1.892; p=0.014), and did not smoke (OR=4.558; p=0.000). The variables of screening follow-up (p=1.000) and OSH compliance (p=0.691) did not show a significant relationship. Increasing the implementation of occupational health screening could support efforts to prevent occupational diseases. This study provides an empirical basis for occupational health programs by emphasizing the importance of early detection, promoting healthy behavior, and preventing smoking as the main strategies.

Keywords: Behavioral Change; Early Detection; Health Screening; Occupational Diseases; Occupational Health and Safety (OHS).

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INTRODUCTION

Occupational health problems (occupational diseases) remain a major challenge in urban areas of Indonesia. With industrial growth, urbanization, and high population mobility, workers in large cities face exposure to risk factors such as indoor air pollution, chemicals, noise, work stress, and unhealthy habits like smoking (1). Many companies have not consistently implemented OSH (Occupational Health and Safety) protocols, and workers often do not undergo regular health checks unless clinical symptoms appear (2). Free annual health screening is considered a potential preventive intervention for early detection, motivation for behavioral change, and increasing knowledge and compliance with OSH (3). However, the effectiveness of these interventions in the Indonesian urban context, including how screening participation, service quality, post-screening follow-up, and moderating factors such as company size, OHS knowledge, and smoking habits, has not been systematically studied (4). Annual health screenings allow for early identification of health problems and work-related risk factors before they develop into more serious illnesses, allowing for more rapid implementation of preventive and control measures (5). Screening helps detect risk factors and early signs of occupational diseases, which are then followed by interventions such as treatment, work environment modification, exposure control, health education, and regular monitoring of worker health to prevent the development of the disease (6).

Data from government institutions and international agencies reinforce the urgency of this topic. The Indonesian government launched a free health screening program in 2025 with a budget of around 3 trillion rupiah, targeting all citizens celebrating their birthdays (adults and children) for examinations of disease risks such as blood pressure, heart disease & stroke risks, as well as vision and mental health checks (5). So far, more than 5.3 million residents have benefited from this program, but there are challenges in covering densely populated areas (6). On the other hand, organizations such as the ILO are promoting the development of a culture of occupational safety and health through the 2024-2029 national OSH (Occupational Safety and Health) program, which aims to reduce workplace accidents and improve the implementation of occupational safety and health systems (7). Despite the continued expansion of national health screening programs and occupational health and safety initiatives in Indonesia, evidence regarding factors associated with successful screening implementation in the working population remains limited. Findings by Suraya et al. indicate that occupational health screenings are capable of identifying a variety of common health problems among workers. However, this study failed to address factors influencing the effectiveness of the screening process, such as worker participation, service quality, early detection, or behavioral changes following screening (10). This knowledge gap highlights the need for research evaluating factors associated with the risk of occupational diseases within the context of occupational health screening.

Several studies in Indonesia have demonstrated that occupational health and non-communicable disease screening play a crucial role in early identification of worker health problems. Studies among formal sector workers have found a high prevalence of obesity, dyslipidemia, lung disorders, and hearing loss detected through regular health checks (10), while research among government employees indicates

that utilization of screening services remains relatively low and is influenced by social support and prior medical history (11). These findings consistently demonstrate the importance of worker participation in screening programs, but are still limited in explaining how the quality of screening services, the effectiveness of early detection, the follow-up of company OHS programs, and worker and company characteristics influence occupational health outcomes. Furthermore, the digital approaches that are beginning to be developed still focus on specific aspects, such as work stress, and have not yet integrated occupational health risk factors more comprehensively (12). Therefore, research that evaluates the various factors related to the effectiveness of occupational health screening in an OHS context more comprehensively is needed.

Although factors such as screening participation, behavioral change, OSH knowledge, and smoking habits have been widely studied separately in the occupational health literature, there is limited research integrating these factors into a single model to evaluate the relationship between occupational health screening implementation and the risk of occupational diseases. Furthermore, empirical evidence regarding the role of screening service quality, early detection, and organizational characteristics such as company size in the context of urban workers in Indonesia is still relatively limited. Therefore, the novelty of this study lies in the development of a model that simultaneously examines the relationship between screening participation, screening service quality, early detection, behavioral change, company size, and smoking habits on the risk of occupational diseases in urban workers in Indonesia.

METHOD

This study used a quantitative method with a cross-sectional approach. This approach was chosen because the study aimed to identify factors associated with occupational diseases among workers at a specific point in time. The study will be conducted in the urban area of Karawang Regency, West Java, which is known as an industrial area with a high number of workers and various health-risk sectors. Subjects were selected based on their participation in the free annual health screening program organized by the local government or companies. The research location was chosen in an urban area with a high level of industrialization because workers in this region have the potential to be exposed to occupational disease risk factors such as respiratory disorders, musculoskeletal disorders, hypertension, and metabolic diseases. Thus, the results of the study can provide insights into the relationship between participation in the annual health screening program and the occurrence of occupational diseases among workers.

The study population consisted of all active workers in the urban areas of Karawang Regency who had participated in the free annual health screening program at least once in the past two years. The research sample was taken using a stratified random sampling method, with a sample size of 258, considering the industrial sector. Data were collected using a structured questionnaire based on occupational safety and health guidelines from the International Labour Organization (ILO), the World Health Organization (WHO), and several relevant previous studies on occupational health screening and

worker health behavior. The research instrument consisted of variables such as screening participation, quality of screening services, early detection, behavioral change, occupational safety and health knowledge, occupational safety and health compliance, smoking habits, and occupational disease risk. Before being used in the main study, the questionnaire was tested on 30 workers with similar characteristics to the study population. The validity test results showed that all items had a total item correlation coefficient (r count) greater than r table (0.361), with a value range of 0.428–0.821, thus all items were declared valid. The reliability test showed a Cronbach's Alpha value of 0.872, indicating that the instrument has good reliability. The assessment procedure was carried out by assigning a score to each item using a Likert scale of 1–5, then summing the scores for each variable. Occupational disease was defined as any work-related illness experienced by workers during the previous 12 months and confirmed by a healthcare professional. The variable was measured using a structured questionnaire and categorized as "yes" or "no". Participation in the free annual health screening program was defined as workers' attendance in the company's program during the last 12 months and was categorized as "participated" or "did not participate".

Data were analyzed using univariate, bivariate, and multivariate analyses. Univariate analysis was used to describe the characteristics of respondents, the level of participation in the screening program, and the prevalence of occupational diseases. Bivariate analysis was performed using the chi-square test to assess the relationship between the independent variable (participation in screening) and the dependent variable (~~reduction~~ in the risk of occupational diseases). Multivariate analysis with logistic regression was performed to measure the most dominant variable in ~~reducing~~ occupational diseases. This study obtained health research ethics approval from the Kadiri University Health Research Ethics Committee with Number 061.2/VI/EC/KEP/UNIK/2025.

RESULTS

Table 1 Distribution of Respondents Based on Characteristics

Characteristics		
	Frequency	Percentage (%)
Sex		
Male	161	62.4
Female	97	37.6
Education		
Low	144	55.8
High	114	44.2
Age		
Young Adults (20-29 years)	113	43.8
Adults (30-59 years)	145	56.2

Table 1 shows that most respondents were male (62.4%) and female (37.6%), with the majority having a low level of education (55.8%) compared to higher education (44.2%). Based on age, the largest number of respondents were in the adult group (30–59 years) at 56.2%, while young adults (20–29 years) accounted for 43.8%. These findings illustrate that the respondents were generally individuals of productive age, predominantly male, and with a tendency toward low educational backgrounds.

Table 2 Factors for Occupational Diseases

Variable	The Risk of Occupational Diseases						P-Value	OR
	Unsuccessful		Succesful		Total			
	n	%	n	%	n	%		
Screening Participation								
No	64	44.4	33	26.5	97	100	0.015	1.964 (1.166-3.308)
Yes	80	49.7	81	50.3	161	100		
Screening Service Quality								
Less	83	73.5	30	26.5	113	100	0.000	3.810 (2.238-6.486)
Good	61	42.1	84	57.9	145	100		
Follow-up After Screening								
Less	8	57.1	6	42.9	14	100	1.000	1.059 (0.357-3.144)
Good	136	55.7	108	44.3	244	100		
Early Detection								
Not done	135	68.2	63	31.8	198	100	0.000	12.143 (5.627-26.203)
Done	9	15.0	51	85.0	60	100		
Behavioral Changes								
Less	107	71.8	42	28.2	149	100	0.000	4.958 (2.908-8.451)
Good	37	33.9	72	66.1	109	100		
Company Size								
Small	103	71.0	42	29.0	145	100	0.000	4.307 (2.547-7.281)
Big	41	36.3	72	63.7	113	100		
OHS Compliance								
Not comply	30	52.6	27	47.4	57	100	0.691	0.848 (0.470-1.530)
Comply	114	56.7	87	43.3	201	100		
OHS Knowledge								
Less	70	64.8	38	35.2	108	100	0.014	1.892 (1.138-3.145)
Good	74	49.3	76	50.7	150	100		
Smoking Habits								
Smoking	79	76.7	24	23.3	103	100	0.000	4.558 (2.611-7.957)
Not smoking	65	41.9	90	58.1	155	100		

The results in Table 2 show that screening participation has a highly significant relationship with a reduction in occupational diseases, with a p-value of 0.015 and an OR of 1.964. This indicates that workers who participate in screening are one times more likely to experience a reduction in the risk of occupational diseases than those who do not participate. The quality of screening services also proved to play an important role, with good services increasing the chances of reducing the risk of occupational diseases by almost three times (p = 0.000; OR = 3.810). Follow-up after screening showed a positive trend with an OR = 1.059 ~~2.194~~, but this was not statistically significant (p = 1.000). Meanwhile, early detection was significantly associated with a reduction in occupational diseases (p = 0.000; OR = 12.143, ~~3.145~~), meaning that workers who were detected early were three times more likely to prevent their health condition from worsening. Behavioral Changes significant relationship with reducing occupational diseases (p=0.000; OR= 4.958). Company size also had a significant effect (p = 0.000; OR = 4.307), indicating that a company size can increase the reduction in occupational disease risk by almost four times.

In addition, compliance with occupational safety and health (OSH) was found to be highly non-significant, with a p-value of 0.691 and an OR of 0.848. Good OSH knowledge is also significantly associated (p = 0.014; OR = 4.558). This indicates that workers with good knowledge have a 4 times greater chance of reducing the risk of work-related diseases. Smoking habits were found to worsen occupational health conditions, with non-smokers having an almost three times greater chance of experiencing a decline in occupational health than smokers (p = 0.000; OR = 4.558).

Table 3 Dominant Factors in Reducing Occupational Diseases

Independent Variables	B	*p-value*	OR	95% CI
Screening Participation	1.781	0.000	5.935	2.468-14.274
Screening Service Quality	1.318	0.000	3.736	1.790-7.800
Early Detection	1.846	0.000	6.335	2.343-17.128
Behavioral Changes	2.205	0.000	9.074	3.815-21.582
Company Size	1.805	0.000	6.082	2.856-12.952
Smoking Habits	1.368	0.001	3.928	1.803-8.556

Based on the multivariate analysis results shown in Table 3, all independent variables have a significant relationship with the reduction of occupational diseases with a p-value < 0.05. However, the most dominant factor is behavioral change with an OR value of 9.074 (95% CI: 3.815–21.582). This means that workers who made healthy behavioral changes after the intervention were more than nine times more likely to experience a reduction in the risk of occupational diseases than workers who did not make behavioral changes.

DISCUSSION

The finding that workers who did not participate in screening had a higher risk of occupational diseases than those who did is consistent with Preventive Health Behavior theories such as the Health Belief Model (HBM) and Theory of Planned Behavior (TPB), which state that beliefs about benefits and perceptions of risk influence preventive behavior. This is also consistent with the study "Health Profile of Formal Sector Workers: A Cross-Sectional Study Based on Worker's Health Check-Up in Indonesia" (2023), which shows that formal workers tend to have better health profiles when they undergo regular medical check-ups, which serve a similar function to screening in detecting diseases early on (8). Low participation rates are often associated with low worker awareness of health risks in the workplace (11). Therefore, screening participation is not only an administrative indicator, but also an important mechanism for primary and secondary prevention in epidemiological theory to reduce exposure, intervene exposure before further damage occurs, and improve long-term health outcomes.

In the present study, workers who perceived the quality of health screening services as good were significantly less likely to have a high risk of occupational diseases compared with those who perceived the service quality as poor. This finding suggests that service quality is not merely associated with workers' satisfaction but may also influence the effectiveness of occupational health screening programs in identifying and managing work-related health risks. In the study setting, workers who reported higher service quality generally indicated that health personnel provided clear explanations regarding examination results and appropriate follow-up recommendations. Such conditions may enhance workers' understanding of their health status and encourage adherence to preventive measures and subsequent health examinations. Conversely, workers reporting lower service quality frequently expressed concerns regarding inadequate information and limited follow-up after screening, which may reduce the effectiveness of the screening program. These findings are consistent with previous studies demonstrating that healthcare service quality influences the utilization of preventive services and compliance with post-screening recommendations (15,16). Similarly, Icanervilia et al. reported that the effectiveness of screening programs largely depends on access to follow-up services and adherence to recommendations after screening.

The results of the study showed that post-screening follow-up was not significantly associated with the risk of occupational disease. This finding indicates that the presence of post-screening follow-up alone is not necessarily associated with differences in the risk of occupational disease in workers. One possible explanation is that the benefits of follow-up are strongly influenced by the quality of implementation, worker compliance with the recommendations, and the length of observation required to produce measurable health changes. In cross-sectional studies, these changes may not be detected because exposure and outcome are measured at the same time. This finding is consistent with a study

by Steel et al., which found that although an occupational health screening program with follow-up showed some initial effects, there were no significant health differences in the follow-up evaluation between groups receiving different screening approaches (18). Furthermore, recent research suggests that a major challenge after screening is not only the availability of follow-up, but also the level of worker compliance with follow-up examinations and implementing the health recommendations (19).

Early detection was significantly associated with the risk of occupational disease in this study (OR = 6.34; $p < 0.001$). This finding suggests that workers with better early detection practices tend to have a different health risk profile than workers with lower early detection practices. However, due to the cross-sectional design of the study, these results represent an association and cannot be interpreted as a causal relationship. This finding is consistent with the literature that places early detection as a critical component of secondary prevention strategies to identify health problems and risk factors at an early stage (22,23). Literature research supports that early detection significantly improves outcomes for many diseases, including occupational diseases such as musculoskeletal disorders, pulmonary disorders, hearing loss, or skin diseases, depending on the type of exposure. The study "Importance of Early Detection in Disease Management" confirms that early detection saves lives, reduces costs, and reduces the burden on public health (19).

People who successfully change their behavior tend to have a lower risk. This aligns with behavioral change theories, such as the Health Belief Model, which emphasizes perceived threats and benefits; the Theory of Planned Behavior, which highlights behavioral intentions and control; and the COM-B (Capability, Opportunity, Motivation Behavior) framework, which explains that behavior is influenced by ability, opportunity, and motivation (25,26). Recent literature (e.g., studies of educational interventions in breast cancer screening based on the Health Action Model) shows that educational interventions designed based on behavioral theory can improve screening knowledge, intentions, and practices (22). In the context of occupational diseases, behavioral changes can include using personal protective equipment, following safety procedures, and promptly reporting symptoms. This research finding confirms that preventive behavior is not merely a demographic factor but a dynamic, modifiable aspect.

Larger companies generally have more resources, formal procedures, and structured OHS programs, making them more capable of providing safety facilities than smaller companies (23). A study in Iran also shows that companies with more than 25 workers almost always have a formal OSH structure, while smaller companies often lack such systems (24). In addition, the literature confirms that organizational capacity influences the implementation of health promotion programs and OHS compliance, with medium and large companies being more consistent than small businesses (25).

Compliance with OHS reflects healthy behavior in the workplace that is directly influenced by health behavior theories such as the Health Belief Model, where perceptions of threats and benefits motivate compliance. Recent research by (2023) showed that compliance with OHS regulations and procedures not only reduces the number of work accidents but also reduces exposure to chronic disease

risk factors, such as exposure to chemicals and dust. Study "Compliance with Standard Occupational Health and Safety among Small-scale Metal Workers" (27) shows that high levels of compliance with health and safety procedures significantly reduce the risk of chronic exposure in the workplace. Therefore, compliance with OSH has a dual role: maintaining short-term safety through accident reduction, and long-term health through mitigating exposure to chronic risk factors.

Knowledge of OSH plays a crucial role in preventing occupational diseases because it builds self-efficacy, which is workers' confidence in their ability to take preventive measures (Bandura). A study shows that Workers' Health Surveillance training improves the self-efficacy of health practitioners, although the increase in knowledge is not always significant (28). Theory-based interventions in female assembly workers also confirm that strengthening self-efficacy is central to musculoskeletal disorder prevention (29). In Indonesia, the OSH training program at SMKN 3 Tegal has been proven to increase participants' motivation and awareness of safety standards, even though it has not directly measured the incidence of skin diseases caused by chemicals (30). This emphasizes the importance of continuing education that not only increases knowledge but also builds workers' practical skills and confidence.

Smoking has been shown to exacerbate the risk of occupational diseases because it not only increases susceptibility to lung disease but also amplifies the effects of exposure to dust and chemicals in the workplace. Studies of coal miners have shown that the combination of smoking and dust exposure significantly increases the risk of COPD compared to non-smokers (31). A similar finding was found in workers with heavy metal exposure, where the interaction of smoking and environmental exposure increased the risk of COPD more than one factor (32). These findings underscore the importance of workplace smoking control interventions as a strategy for preventing occupational diseases.

The strength of this study lies in the multivariate analysis, which provides a comprehensive overview of factors associated with occupational disease prevention. However, its limitation is its observational study design, which cannot confirm causal relationships. Furthermore, the data are sourced from employee reports, which can potentially introduce information bias. Further research could be developed using a longitudinal approach, company-based interventions, and the integration of biomarker data to strengthen the validity of the findings.

CONCLUSIONS AND RECOMMENDATIONS

Overall, this study shows relationships among screening participation, quality of screening services, early detection, behavioral changes, company size, and smoking habits and the risk of occupational diseases. These findings are consistent with health behavior theory and international literature, and provide direct evidence for occupational health policies and preventive intervention programs in public health. Despite limitations in design and generalizability, this study provides a strong foundation for developing more effective models for occupational disease prevention.

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