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EMPOWERING MANUAL HANDLERS: A COMPREHENSIVE ERGONOMIC AWARENESS TRAINING PROGRAM IN PLASTIC MANUFACTURING KULAI, JOHORE

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Abstract:

Background: Ergonomic awareness training programs are known for their methodical approach to identifying and mitigating workplace risks and have been associated with decreased Musculoskeletal Disorders (MSDs). MSDs were prevalent in manufacturing including the plastic industry, causing significant health and economic impacts. However, research on ergonomic interventions in this sector is limited. **Objective:** The primary aim of this study is to assess the effectiveness of ergonomic awareness programs among manual handling workers in the plastic tray manufacturing industry, with a focus on tasks related to forming and packing. **Methods:** This study was conducted in a plastic tray manufacturing facility in Kulai, Johor, that targeted workers involved in high-risk ergonomic tasks such as forming and packing, with

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exposure to ergonomic hazards for up to 12 hours daily. A total of 108 workers participated, receiving ergonomic awareness training and completing survey questionnaires. **Results:** The results revealed that post-training showed significant improvement ($p<0.01$) in workers' ergonomic awareness, indicating the effectiveness of the ergonomic training program in enhancing knowledge ($t=12.92$), attitudes ($t=14.77$), and practices ($t=16.29$). **Conclusion:** The findings highlight the critical role of enhanced ergonomic awareness in emphasizing the necessity for industry-specific, customized ergonomic training in the plastic tray manufacturing industry. It is suggested the implementation of these focused training programs to strengthen workplace safety and health, encourage ergonomic awareness, and lessen the long-term development of MSDs.

Keywords:

Musculoskeletal Disorders, Ergonomic Training, Ergonomic Risk Assessment, Packing, Forming

Introduction

Manual handling in the manufacturing industry poses a significant and multifaceted challenge, primarily due to its potential to cause Musculoskeletal Disorders (MSDs) (Andia-Fernandez et al., 2022). Manual handling encompasses a wide spectrum of activities where workers rely on their physical strength and body movements to manipulate objects, often without the assistance of mechanical devices (Tang, 2022). These activities encompass a range of tasks, including lifting and transporting raw materials, operating machinery, assembling, and packing products, and performing maintenance and cleaning duties (Yusof et al., 2022). In the context of the plastic manufacturing sector, these manual handling tasks are pervasive and represent a substantial source of concern.

In the realm of plastic manufacturing, employees are frequently engaged in physically demanding tasks (Mohamed et al., 2018; Mohamad Jamil et al., 2023). These tasks often include the lifting and transportation of heavy materials, exemplified by bags laden with plastic pellets. Such activities not only necessitate the lifting of considerable weights but also expose workers to the risk of strain and injury stemming from repetitive motions (Venkatachalam et al., 2023). A further area of ergonomic concern is the process of feeding materials into machinery and operating these machines, which typically involves repetitive muscle movements (Fazi et al., 2019; bin Nik Ahmad Ariff, 2020). This is particularly pronounced in tasks that require continuous hand motions or the maintenance of a static posture over prolonged periods (Diyana et al., 2017).

Occupational MSDs constitute a pressing issue in occupational health in Malaysia, presenting a significant challenge concerning workplace safety and employee well-being (Diyana et al., 2019; Jamil et al., 2021). According to data from the Department of Statistics, Malaysia recorded a total of 5,289 cases of occupational diseases in 2021, with MSD accounting for 201 cases, underlining their prominence as a critical health concern (Department of Statistics Malaysia, 2023). The manufacturing sector, in particular, contributes significantly to these statistics, with 130 cases attributed solely to this industry. These figures highlight the need for focused research and interventions in the manufacturing sector to effectively address and mitigate the risks associated with Occupational MSDs.

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Manual handling activities, which encompass actions such as lifting, lowering, pushing, pulling, carrying, restraining, or holding loads manually, are a primary driver of these disorders. According to the DOSH Guidelines for Manual Handling (2018), these activities are responsible for 40% of reported MSD cases in Malaysia. MSDs commonly result in sprains and strains to the lower back, shoulders, and upper limbs, leading to chronic pain, disability, and the need for medical care, posing substantial challenges for both affected individuals and their employers. The impact extends beyond physical health, encompassing significant financial implications. The Social Security Organization (SOCSO) of Malaysia underscores the substantial costs associated with MSDs, including direct expenses like medical treatment and compensation, as well as indirect costs such as lost productivity, absenteeism, and the expenses incurred in training replacement workers. The economic impact of Musculoskeletal Disorders (MSDs) within the manufacturing sector is notably significant. Data from the Social Security Organization (SOCSO) reveals a marked escalation in financial compensations linked to occupational illnesses, encompassing both permanent and temporary disabilities. Specifically, between 2009 and 2014, there was a rise in the payouts for such health issues, with reimbursements escalating from RM2.65 million to RM14.05 million (Syed Muhamed et al., 2018). This increasing trend in compensations related to MSDs substantially augments the total financial burden imposed by occupational diseases in the industry. As outlined by Imtihan et al. (2022), the risk of physical harm to workers is particularly elevated during manual packing operations when the workload is excessive. Workers' complaints of pain in their hands and backs were often attributed to manual labor techniques performed with poor ergonomic posture. Additionally, the study by Madhwani et al. (2017) highlighted the potential of quick, 10-minute programs to raise awareness effectively, given their practicality, widespread applicability, and capacity to instill a sense of care and trust in a robust office ergonomics program.

The pivotal role of ergonomic awareness in mitigating risks associated with manual handling in the manufacturing sector is critical. The 2018 "Guidelines for Manual Handling in the Workplace" take significant strides in providing practical solutions to ergonomic challenges. Yet, their success fundamentally depends on the degree of ergonomic knowledge and commitment among employers, employees, and safety professionals. At the heart of this issue is the recognition and understanding of the hazards inherent in manual handling tasks, coupled with the application of effective strategies to mitigate these risks. Therefore, while these guidelines establish a comprehensive approach to managing manual handling risks, the transformative impact is achieved through the cultivation of an organization-wide ergonomic consciousness. It is this heightened awareness that paves the way for significant reductions in the occurrence of Occupational MSDs in the Malaysian manufacturing sector (Selamat et al., 2020; Yusof et al., 2014). Therefore, the aim of this study is to assess the effectiveness of ergonomic awareness programs among manual handling workers in the plastic tray manufacturing industry.

Methodology

Study Design

A one-group pretest-posttest design was carried out among 108 respondents for this ergonomic training awareness. This study was conducted and assessed twice: once before an ergonomic training (pretest) and once after the training (posttest). The primary goal of this design is to determine whether the ergonomic awareness training had an impact on the participants'

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outcomes by comparing their performance before and after exposure to the intervention. This study was carried out in the plastic tray manufacturing company located in Kulai, Johor.

Sampling Unit

The sampling unit for this study comprised all employees at a plastic tray manufacturing company situated in Kulai, Johor. Specifically, the focus was on individuals engaged in manual handling tasks within the forming and packing divisions of the company, including both manual workers and members of the managerial team. In the forming and packing division of plastic manufacturing, manual handling tasks play a pivotal role in the production and distribution process. Workers are regularly engaged in physically demanding activities, including the movement of raw materials such as plastic resins and molds, machine operation, product inspection, packaging, palletizing, and transportation, which often work up to 12 hours per day. These tasks require workers to lift, carry, push, pull, or manipulate plastic materials and products that involve heavy loads and repetitive motions. The lists of names for this sampling unit were obtained from the Human Resources Department of the company.

Sample Size

There are 150 respondents who are working in the forming and packing area. To obtain reliable and valid results, the sample size needed for this study was determined to be 108. This calculation was based on the formula established by Krejcie and Morgan in 1970.

Study Procedure

Before agreeing to participate in this study voluntarily, each participant was explained briefly on the questionnaire, and an official consent form was collected from each respondent to participate in this study. The sampling method used in this study was simple random sampling. The study used a one-group pretest-posttest design to assess the impact of ergonomic awareness training on the respondents. The procedure commenced with the administration of a questionnaire during the pretest phase. In this initial assessment, participants were asked to respond to a set of questions related to ergonomic knowledge and awareness. Following the completion of the pretest questionnaire, ergonomic training was provided to the respondents. This training aimed to enhance their understanding of ergonomic principles, safe handling techniques, and the recognition of workplace hazards associated with manual handling tasks. After the training intervention, the posttest phase was initiated, mirroring the pretest questionnaire to maintain consistency. The same set of questions was presented to the participants, allowing for a direct comparison of their responses before and after the ergonomic training. This approach facilitated the measurement of the effectiveness of the training program in improving ergonomic awareness among the study participants. Figure 1 depicts the research flow utilized in this study.

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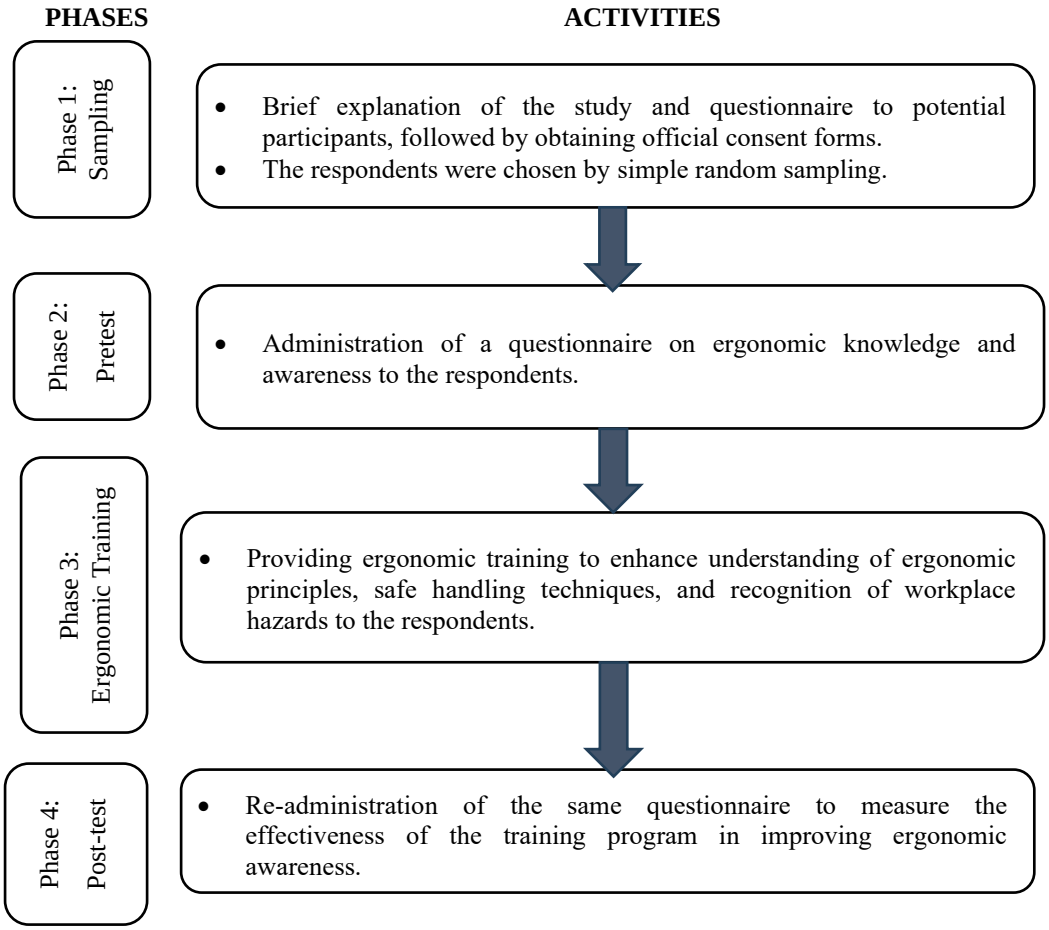

Figure 1. The Flow Chart Of The Research Procedure

Study Instrumentation

Questionnaire

The development of the questionnaire items drew inspiration from the "Guidelines on Ergonomics Risk Assessment at Workplace" (DOSH, 2017) and a modified version of the KAP (Knowledge, Attitude, and Practices) questionnaire by Nordin et al. (2016) for assessing knowledge and awareness. The questionnaire itself was structured into two sections: A, and B. Section A covered demographic information, and Section B delved into Knowledge and Awareness of Ergonomics, adapting questions from the Knowledge, Attitude, and Practices (KAP) questionnaire related to ergonomics using a 5-point Likert scale. The questionnaires were distributed to selected respondents from two departments: forming and packing.

Ergonomic Training Awareness

The training program lasted for approximately 4 hours, consisting of 2 hours dedicated to theoretical content and 2 hours for practical application. This program was designed to cover fundamental concepts, rules, and behaviours aimed at preventing musculoskeletal disorders among workers. It included topics such as the anatomical structure of the back, factors influencing back health, posture and body mechanics, ergonomics, safe patient handling, the use of lifting devices, and other preventive measures. The training program was delivered to six groups, each comprising 10 to 16 individuals, and was spread across 2 days as shown in

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Figure 2. Prior arrangements were made to establish an effective learning environment before the commencement of the training program. Additionally, participants were provided with explanations regarding the program's objectives and scope. The training topics were presented using interactive discussion techniques, with the aid of PowerPoint slides.

Figure 2. Ergonomic Awareness Training

Statistical Analysis

All the data collected through the questionnaire underwent analysis utilizing IBM SPSS (Statistical Package for the Social Sciences) version 27. The analysis encompassed both univariate and bivariate approaches. The study was conducted with a confidence level of 95% and a statistical power of 80%, with results considered significant at $p \leq 0.05$. Remarkably, the examination of data variables revealed a normal distribution pattern. Consequently, this study opted for parametric testing methods. Given the comparison of data from two distinct phases (pretest and post-test), the paired t-test emerged as the appropriate statistical tool for analyzing independent numerical variables.

Evaluation Instrument

In this study, the test-retest method was utilized to evaluate the validity of a questionnaire, which was an adapted version of an existing instrument with some modifications for assessing respondents' Knowledge, Attitudes, and Practices (KAP) regarding ergonomics. The process involved administering the same questionnaire initially and then again in a retest. This technique was aimed at assessing the stability and dependability of the responses over time, thereby verifying the questionnaire's validity as a tool for measurement. The questionnaire comprised 15 items, divided into three sections: knowledge (K1-K6), attitude (AW1-AW6), and practice (P1-P3). Each item was rated using a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). The internal consistency of the questionnaire was found to be high, with Cronbach's alpha coefficients of 0.87 for knowledge, 0.86 for attitude, and 0.87 for practice. Furthermore, according to Landis and Koch (1977), kappa values below 0.20 are considered poor, and those above 0.81 are very good. In this study, the kappa coefficients were consistently in the good to very good range, indicating satisfactory test-retest reliability, as corroborated by Rosecrance et al. (2002).

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Results

The Sociodemographic Of The Respondents

A total of 108 respondents successfully completed the survey questionnaire, representing both the forming and packing departments. As illustrated in Table 1, the majority of participants were male, comprising 77 workers (71.3%). Regarding nationality, the most prominent group in this study was of Nepali origin, with 38 participants, constituting 35.2% of the total. This demographic observation aligns with the composition of workers in the forming and packing departments, where a significant portion of the workforce hails from Nepal. In terms of age distribution, respondents aged between 26 and 35 years constituted the largest group, with 49 respondents (45.4%). Similarly, when considering working experience, the category of 2-5 years of experience was the most common, with 42 respondents, accounting for 38.9% of the participants. Furthermore, the majority of participants had attained a high school education level, with 70.4% of the sample. Additional demographic characteristics can be found in Table 1.

Table 1. Sociodemographic of Respondents

Variables		Frequency (n)	Percentage (%)
Gender	Male	77	71.3
	Female	31	28.7
	Total	108	100
Age	17-25 years	13	12
	26-35 years	49	45.4
	36-50 years	26	24.1
	51-65 years	20	18.5
	Total	108	100
Working experience	0-1 year	24	22.2
	2-5 years	42	38.9
	6-9 years	30	27.8
	More than 10 years	12	11.1
	Total	108	100
Nationality	Malaysia	21	19.4
	Bangladesh	12	11.1
	Nepal	38	35.2
	Myanmar	17	15.7
	Vietnam	20	18.5
	Total	108	100
Education	No formal education	25	23.1
	High School/SPM level	76	70.4
	Vocational or Certificates	3	2.8
	Bachelor's Degree	4	3.7
	Total	108	100

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Ergonomic Awareness Training

In this research, a comprehensive analysis was conducted to assess the effectiveness of an ergonomic awareness training program. The focus was on three key variables: Knowledge, Attitude, and Practice, measured through pre-test and post-test evaluations. The results revealed remarkable improvements across all dimensions following the training as shown in Table 2. Overall, there are significant differences between the pretest and post-test scores in these four variables ($p<0.01$). These results hold important implications for workplace health and safety, emphasizing the importance of such training initiatives in promoting ergonomic practices and reducing the risk of musculoskeletal disorders.

Table 2. The Comparison of Ergonomic Training Awareness Scores Between The Pretest and Post-Test

Variable	Mean (SD)		Mean differences (95% CI)	t statistics	p-value
	Pre-test	Post-test			
Knowledge	1.38 (0.45)	1.53 (0.39)	0.16 (0.13,0.17)	12.92	<0.01*
Attitude	2.92 (1.16)	3.37 (0.47)	0.45 (0.26, 0.64)	14.77	<0.01*
Practice	2.46 (0.78)	2.75 (0.40)	0.29 (0.20, 0.39)	16.29	<0.01*

Discussion

This study focused on evaluating the effectiveness of an ergonomic awareness training program among workers in the forming and packing divisions of a plastic tray manufacturing company. One of the key outcomes of this study is the significant improvement in employees' ergonomic knowledge, practice and awareness which all the data showed a significant diffences between pre-test and post-test of the in this ergonomic training awareness. This proved that the participants' successfully showed understanding of ergonomic hazards, including factors like awkward postures, repetitive motions, forceful exertion, and static postures, notably evolved from the pre-training to the immediate post-training phase. This shift in the perception of workplace hazards is particularly significant, as it reflects a deeper understanding of the risks commonly associated with the plastic tray manufacturing industry (Reiman et al., 2021; Ciccarelli et al., 2023). This finding aligns with existing literature, which underscores the importance of employees recognizing and addressing these hazards (Karmegam et al., 2020; Putri et al., 2020). Armed with this knowledge, workers are better equipped to proactively implement changes in their workspaces and personal behaviors, contributing to enhanced workplace safety.

The training program led to significant improvements not only in participants' knowledge and awareness but also positively impacted their attitudes and practices concerning ergonomic principles. Post-training observations indicated a marked shift towards safety-conscious attitudes and the implementation of ergonomic practices. This was particularly evident in responses to the item AW1 (*"High task repetition at workplace can contribute to the formation of work-related musculoskeletal injuries?")* and AW4 (*"Appropriate lighting and elimination of glare in the work area will make worker misjudge weight and object shape, resulting in inappropriate or poor lifting techniques?"),* Participants demonstrated increased awareness of the technical aspects of ergonomics, such as lighting, which is crucial for maintaining workers'

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eyesight during tasks. This heightened awareness is vital for preventing accidents and fostering long-term health improvements among workers. This aligns with research findings by Zara et al. (2023) and Hess et al. (2020), which emphasize the importance of engaging in safety and health training programs. Such programs enhance knowledge acquisition, foster skill development, and address weaknesses in workplace safety protocols (Chatigny, 2022; Vigoroso et al., 2021).

The results also showed significant differences in the practices of the respondents ($p<0.05$) which the key question involved P1-P3, namely, P1*: "To prevent musculoskeletal injuries, should a worker use available tools (e.g., trolley/pallet jack) for heavy things?"* P2: *"Do you regularly check the height level of your workstation?"* P3: *"Do you personally do annual health screening?"*. Prior to the intervention, responses to these questions indicated a limited understanding and application of ergonomic practices. For instance, in P1, many workers might not have recognized the importance of using tools like trolleys or pallet jacks to move heavy items, thereby putting themselves at risk of musculoskeletal injuries. Similarly, P2 and P3 responses likely showed a lack of regular workstation adjustments and infrequent health screenings, reflecting a gap in ongoing ergonomic and health maintenance. The post-intervention responses exhibited a significant shift for all the items (Nordin, 2016).
This shift suggests that the training successfully imparted the knowledge and importance of using ergonomic tools in daily work tasks and an increased proactive approach to ergonomics at the individual level. This was supported by Sorensen et al. (2021) which they agreed that the changes play a role in reflecting a broader understanding of how personal health impacts work performance and the importance of regular health assessments in identifying potential work-related health issues. The training not only improved knowledge and attitudes but also led to tangible changes in daily work practices. This shift towards more ergonomic-conscious behaviors is crucial in reducing workplace injuries and enhancing overall worker health and safety (Kosy et al., 2020; Jensen et al., 2021). Moreover, the study underscores the value of ergonomic interventions in fostering a culture of safety and preventive health care in the workplace.

Participants' feedback from the training program indicates a keen interest in workplace safety and health among plastic tray manufacturing workers. The interactive nature of the training allowed participants to address hazards specific to their work environment and formulate practical solutions. Moreover, the training effectively influenced how seriously workers perceived certain hazards, aligning with findings in the literature.

Conclusion

In conclusion, this study highlights the positive impact of ergonomic awareness training on employees' knowledge, awareness, attitude, and practice in the plastic tray manufacturing industry. While selection bias is acknowledged, the findings underscore the eagerness of workers to engage in safety and health training and their ability to translate newfound knowledge into safer workplace practices. These insights contribute to the growing body of literature on occupational safety and health (OSH) training for workers in the plastic tray manufacturing sector, emphasizing the importance of ongoing initiatives to enhance workplace safety and health. It is worth noting that this training program exhibited selection bias, as it was self-directed and primarily attended by workers from the forming and packing divisions. While this limitation means that the findings may not fully represent the entire organization, it

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highlights the enthusiasm and commitment of employees in these divisions toward prioritizing workplace safety and health.

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