ORIGINAL ARTICLE

Validity and Reliability of Finger Safety Training Evaluation (FingSTEv) to Measure Finger Safety Knowledge Among Manufacturing Industries Workers at Small and Medium Enterprise in Selangor

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ABSTRACT

Introduction: Finger injuries are prevalent in manufacturing, particularly in SMEs, leading to significant physical and financial consequences, highlighting the urgent need for effective intervention to mitigate these risks. Intervention on finger safety helps employees perform their tasks safely and effectively, thereby enhancing their competencies. The Finger Safety Intervention Modules (FingSIM) comprehensively address the critical aspects of occupational finger accidents and injuries (OFAI). However, a validated instrument to assess its efficacy for future improvement and sustainability has been lacking. This research aims to validate the Finger Safety Training Evaluation (FingSTEv), designed to measure the knowledge of workers in Selangor's small and medium enterprise (SME) manufacturing industries. **Materials and methods:** The FingSTEv was developed utilizing occupational accident and injury data, a literature review, and an expert evaluation. FingSTEv's Internal Consistency Reliability (ICR) was determined via Kuder-Richardson 20 (KR-20). **Results:** The analysis of the Itemized Content Validity (I-CVI) and Scale Content Validity (S-CVI) validated its validity. The S-CVI for relevance, clarity, simplicity, and ambiguity ranged from 0.9899 to 0.9966. The S-CVI of FingSTEv is 0.9924. With a KR-20 value of 0.84, the ICR of FingSTEv revealed a significant link between the questions. **Conclusion:** FingSTEv exhibited excellent content and face validity, along with a high ICR, making it an effective, reliable, and valid tool for assessing finger safety knowledge. Its robust validation ensures that it effectively measures the intended knowledge areas, supporting the ongoing enhancement and sustainability of occupational finger safety initiatives.
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Keywords: Finger, Manufacturing, Occupational safety and health, Reliability, Validity

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INTRODUCTION

Occupational finger accidents and injuries (OFAI) are acknowledged as major workplace safety concerns. However, compared to emerging communicable diseases, there is a critical lack of detailed information to guide effective policy-making and injury prevention strategies. Between 2017 and 2019, Malaysia experienced a significant rise in OFAI, correlating with the rapid expansion of its industrial sectors. The JKKP8 data from the Department of Occupational Safety and Health (DOSH) and the Malaysia Social Security Organization (SOCSO) reveal that fingers were the most frequently injured body part, with DOSH reporting 26.25 percent and SOCSO documenting 13.53 percent of OFAI incidents. Similarly, Severe Injury Reports (SIR) from the United States Department of Labor (USDOL) indicated that 29.63 percent of severe injuries involved fingers.

Fingers are consistently identified as the most vulnerable body parts in workplace injuries. Addressing workplace safety involves both internal measures by companies and external actions by government agencies and other stakeholders (1). Effective safety interventions typically encompass various components such as awareness campaigns, employee training, legal reforms, and machine guarding (1) . These interventions aim to reduce the frequency and severity of workplace accidents. Prior research underscores the critical role of training in accident prevention. Training, defined as the acquisition of skills necessary for specific job functions, is widely recognized as a cornerstone of occupational safety and health (OSH) management programs. It is imperative for organizations to ensure that their training programs equip employees with the knowledge to handle hazardous situations safely (2).

Comprehensive pre-employment training, regular safety drills, and ongoing education are vital for preventing OFAI (3). Training content should cover machinery and control mechanisms, including safety guards and automatic shut-off features for machinery (4). Additionally, the recertification of safety engineers and stricter machinery safety regulations are crucial for reducing hand injuries (5). Environmental interventions also play a role by improving workplace conditions and reducing absenteeism and early retirement due to environmental factors (6). Developing an effective intervention module requires identifying all root causes and characteristics associated with OFAI (7). A notable gap in the prevention of OFAI is the insufficient knowledge and evaluation of existing training modules, including the analysis of the validation and reliability conducted on the instruments developed for OFAI prevention (5).

Education is vital for establishing a robust safety and health culture focused on prevention. In Malaysia's SME manufacturing sector, developing an intervention module on occupational finger safety is essential to enhance workers' knowledge and improve overall OSH (8). Such a prevention strategy can significantly reduce workplace accidents and finger injuries. This specialized intervention module aims to educate employees on all aspects of finger safety, specifically targeting the gaps created by insufficient training that leaves workers vulnerable to complex and unrecognized hazards (9). Structured training modules have proven effective in promoting efficient OSH training across various contexts. Tailored modules are crucial for conveying specific knowledge, and they can be expanded with additional content (10). The insights gained from these training interventions lead to lasting improvements (11). In this context, the intervention module is designed to improve the knowledge of SME manufacturing workers on finger safety, ensuring that the content is accessible and relevant to the participants' backgrounds.

Analysis of OFAI data from DOSH (2017-2019) and USDOL (2015-2019) highlights that hand tools and machinery are primary contributors to these injuries. Workers, particularly in the SME manufacturing sector, face heightened risks. In 2017, SMEs contributed 7.6 percent to Malaysia's national GDP, with 47,698 in the manufacturing sector, the second largest after services. Selangor, with 19.8 percent of Malaysia's SMEs, has the highest concentration. In response to these findings, the Finger Safety Intervention Module (FingSIM) was developed to address this critical aspect. The FingSIM, was developed through a multifaceted approach incorporating secondary data analysis of the JKKP8 register (2017–2019), comprehensive reviews of Malaysian legislation, international directives, ILO conventions, and literature, alongside expert consultations. This rigorous process identified key characteristics, including the sources and demographics of finger-related accidents, ensuring the module's relevance and focus on targeted safety measures.

The FingSIM module serves as the foundational intervention for the development of FingSTEv, ensuring that the evaluation tool aligns closely with the key safety principles and knowledge imparted during training. FingSIM is a comprehensive educational framework comprising five critical topics designed to enhance workers' awareness and understanding of finger safety in high-risk occupational settings: introduction to finger safety, machine safety, hand tools safety, personal protective equipment (PPE), and first aid response and accident notification. Each topic is meticulously structured to address essential safety concepts and practices.

The introduction to finger safety topic provides a foundational understanding of the importance of finger safety, the anatomy of human fingers, and the principles of hazard identification, risk assessment, and risk control (HIRARC). It contextualizes these principles with real-world examples, such as prosecution cases involving finger injuries reported by the DOSH, alongside statistical data from SOCSO and JKKP8 reports. Machine safety focuses on the risks posed by machinery, covering legal requirements for machine guarding, employer and employee responsibilities, and strategies for mitigating mechanical hazards. This includes topics such as the principles of safety barriers, energy control programs, and critical practices like the Lockout-Tagout (LOTO) program.

The hand tools safety topic educates workers about the types of hand tools used in the workplace, emphasizing safe handling practices, employer and employee responsibilities, and procedures for using both manual and power tools. Complementing this, the personal protective equipment (PPE) section emphasizes the significance of personal safety devices, detailing legal requirements, proper usage guidelines, and the selection of safety gloves and additional finger protection equipment. The final topic, first aid response and accident notification, focuses on immediate responses to finger injuries such as amputations, lacerations, burns, and fractures, alongside legal requirements and procedures for accident reporting to ensure regulatory compliance. Upon completing the module, a panel representing diverse disciplines from DOSH was appointed to review its content. The panels provided detailed feedback and insights, contributing to the refinement of the draft intervention module.

The FingSTEv was developed by transforming the key information from the FingSIM module into structured questions, ensuring the evaluation tool accurately reflects the core principles and safety measures from the training. Each question in FingSTEv is designed to assess workers' retention and understanding of critical topics, such as HIRARC principles and machine safeguarding techniques, directly corresponding to FingSIM's content. This integration allows FingSTEv to effectively measure the impact of the training while also identifying areas needing further attention. By aligning closely with FingSIM, FingSTEv supports a culture of safety and helps reduce occupational finger injuries, especially in high-risk industries.

A valid and reliable tool is essential for evaluating the effectiveness of a program, particularly in assessing the impact of finger safety training. To measure the effects of such training, especially in relation to key practices for enhancing workplace safety, a robust and valid instrument is necessary. Validity refers to how well data from an instrument measure what it is intended to measure. An instrument is considered valid if it accurately collects data on its intended subject (12). Expert evaluation is crucial for establishing validity, and using multiple validation techniques, such as face and content validity, can enhance an instrument's effectiveness (13). This study assessed both face and content validity to ensure the instrument's appropriateness before it was used with survey participants.

Face validity relies on subjective evaluations of a measurement instrument's surface appearance, without the support of established theories or formulas (14). The main challenge is that an instrument might be disregarded despite its theoretical soundness. Face validity assesses aspects like feasibility, readability, style consistency, language clarity, and overall presentation. For the FingSTEv, simple language was used to accommodate respondents with reading difficulties (14). This approach ensures that the survey items appear relevant, reasonable, and clear to both the researchers and the experts reviewing it. Experts provided feedback to confirm that the questions were appropriate, understandable, and unambiguous (15).

Content validity refers to how well items in an instrument reflect the relevant content universe for generalization. It is essential for newly developed instruments to confirm their research relevance. This process assesses whether the instruments are suitable for their intended purposes. Evaluating content validity requires subjectivity to determine the scale's ability to measure a desired trait (16). Instrument construction should be the initial step in this process (17). A quantitative approach enables researchers to gather evaluations from experts across diverse locations, regardless of distance.

This study aims to develop, validate, and assess the internal consistency reliability (ICR) of FingSTEv, a self-administered questionnaire designed to measure employees' knowledge of finger safety. Notably, no existing instruments specifically and reliably assess finger safety knowledge, making FingSTEv a unique contribution to the field.

MATERIALS AND METHODS

Questionnaires are among the most commonly utilized tools for data collection, particularly in social science research. Their primary purpose is to gather relevant information in a reliable and valid manner. Therefore, the accuracy and consistency of survey instruments—essential components of research methodology—are critical for ensuring validity and reliability. The development and validation of FingSTEv encompassed three key processes: the development of the tool itself, evaluation of its face and content validity by expert panels, and assessment of reliability through a pilot study involving a sample of workers from SMEs in the manufacturing sector.

Development of FingSTEv

The conceptual framework posits that the sociodemographic characteristics of workers, along with prior occurrences of OFAI and factors related to the workplace environment, may influence their level of knowledge regarding finger safety. The FingSTEv questionnaire was designed to include factual information from the FingSIM and was carefully crafted for clarity to minimize misunderstanding and engage participants. FingSTEv comprises three sections: A1 - sociodemographic information, A2 - finger accidents and injuries at work, and B - knowledge of finger safety.

The questionnaire was developed in Bahasa Melayu to ensure clarity and ease of comprehension among respondents. Bahasa Melayu, recognized as the national language under Article 152 of the Federal Constitution, was chosen for its widespread use and familiarity among Malaysian workers, particularly in this study's context. The researcher prioritized avoiding complex or ambiguous terms and ensured that the language was succinct and straightforward. Using a language other than the respondents' primary language could lead to misunderstandings and inaccuracies in their responses, compromising the reliability of the data. By adopting Bahasa Melayu, the questionnaire effectively addressed cultural and workplace-specific linguistic factors, ensuring the questions were accessible and relevant to the target population (18–20). The following Table I outlines the FingSTEv structure.

Table I: Structure of Questions in Questionnaire

Section	Question	Number of Question	Item
A1	1-5	5	Sociodemographic of participants
	6-9	4	Employment characteristics
	10-12	3	Previous participation in OSH training
	13-14	2	Previous training on finger safety
	15	1	Information channel on finger safety
	16-17	2	Issuance of personal protective equipment
	18	1	Issuance of additional finger protective equipment
A2	19-39	21	Previous history of finger accidents and injuries at workplace
B	1-2	2	Legislation
	3	1	Finger anatomy
	4a-4h	8	Hazard identification, risk assessment and risk control
	5a-5g	7	Machine safety
	6a-6f	6	Lockout and Tagout
	7a-7e	5	Hand tool safety
	8a-8g	7	Personal protective equipment
	9a-9f	6	First aid response
	10a-10h	8	Notification of accidents

Expert's Review

Expert assistance in the design of the instrument was crucial for its improvement. Designating five to ten experts is essential for evaluating the scale's content areas using rating scales, thereby minimizing random agreements (21–23) The selection of experts is a critical component of the validation process. Experts were chosen based on a diverse range of knowledge and work experience and involvement in OSH to ensure comprehensive feedback. This panel, comprising OSH policymakers, industrial engineers, and social studies experts with active involvement in developing OSH training modules. This diversity ensures a comprehensive evaluation of the instrument, drawing on the unique perspectives and expertise of each expert. The participation of these experts is not only instrumental in assessing the instrument's validity but also in enhancing its overall quality. It is imperative that these experts are not only available but also willing to engage thoroughly in the validation process.

Experts assessed each question on a four-point Likert scale, focusing on relevance, clarity, simplicity, and ambiguity. They were given sufficient time to review FingSTEv, ensuring it accurately measures its intended purpose and allowing them to suggest modifications or additional items. Both expert comments and identities remained anonymous. Ratings of 3 (relevant but needs minor revision) and 4 (very relevant) indicated positive assessments, while ratings of 1 (not relevant) and 2 (item needs some revision) signaled concerns (5,24). Validation findings were presented through computations of ratios and indices (25,26).

Itemised Content Validity Index (I-CVI)

The content validity index (CVI) is commonly used to evaluate the content validity of the overall study instrument (25). Using the index from 1 to 4 for the four criteria of relevance, clarity, simplicity, and ambiguity, the experts should assign a numerical rating to each question. The FingSTEv content validity was determined statistically using an I-CVI and S-CVI. The I-CVI for each item was calculated by dividing the number of experts who rated 3 or 4 by the total number of experts. Similarly, the Scale-Content Validity Index (S-CVI) was calculated by aggregating each I-CVI scale and dividing it by the total number of items.

Reliability

Reliability measures the extent to which a measurement instrument yields stable and consistent results (27,28). It is crucial for assessing the instrument's consistency and quality, with repeatability determining whether similar results are produced across multiple measurements or conditions (29). To evaluate the ICR of the FingSTEv, the Kuder-Richardson 20 (KR-20) method was used. The KR-20 was applied to binary response questionnaires of varying difficulty (30), yielding values from zero to one. Low values indicate weak reliability. A coefficient of 0.9 or above (31) signifies a homogeneous test, whereas a coefficient greater than 0.7 (16) is deemed acceptable. A pilot study was conducted involving 40 manufacturing workers from a small and medium-sized enterprise (SME) in Kepong, Selangor, to evaluate the reliability of the FingSTEv instrument. The study focused on assessing the instrument's relevance, clarity, intelligibility, and appropriateness for the target population, as well as estimating the time required to complete the questionnaires. These respondents, who shared homogeneous characteristics with the actual study participants, were purposefully excluded from the main study to maintain its integrity. The pilot study served as a critical step in refining the instrument by identifying potential improvements and ensuring its suitability for broader implementation. The results provided essential insights into the reliability of the questionnaire, laying a solid foundation for its application in subsequent research.

Ethical Clearance

The data were collected with the permission and approval of the Medical Research Ethics Committee, Ethic Committee for Human Subjects Research (JKEUPM), Universiti Putra Malaysia (UPM) with reference number JKEUPM-2020-270.

RESULTS

Following the confirmation of the intervention module's content, the FingSTEv, which serves as the primary tool for the quantitative study was developed based on the information from FingSIM. The FingSTEv which was developed in three stages: developing the questionnaire, assessing its face and content validity, and testing its reliability, evaluates workers' knowledge on essential topics such as finger safety, machine safety, hand tool safety, personal protective equipment, and first aid response and accident notification. Participants' knowledge of finger safety was assessed through a pre-test, a post-test, and a second post-test three months later. The study employed a quasi-experimental interventional study design and involved 192 manufacturing workers from 14 SME factories in Selangor.

The FingSTEv was reviewed by a diverse panel of 10 experts, including six from DOSH, two from Universiti Putra Malaysia (UPM), one from Universiti Teknologi Mara (UiTM), and one from Queen's University Belfast (QUB). Of the 10 selected experts, 90 percent have over 10 years of experience in OSH, with 40 percent holding a PhD and the remaining 60 percent possessing a Master's degree. Each expert was appointed formally to assess the questionnaire's validity and relevance, offering confidential recommendations for improvement. Using a multi-panel selection procedure with varied backgrounds and disciplines prevents biases and errors.

I-CVI and S-CVI and ICR

Validity and reliability testing for FingSTEv have been completed, confirming that it effectively measures the intended constructs and yields stable, consistent results. The internal consistency of FingSTEv was assessed using the Kuder-Richardson 20 (KR-20) coefficient. Subject matter experts evaluated each question using a four-point Likert scale, assessing its relevance, clarity, simplicity, and ambiguity in the questionnaire's validity, while participants from similar backgrounds contributed to its reliability.

The analysis unequivocally demonstrates that the instrument is both valid and suitable for the present study. Substantially, each question demonstrated an Item-Content Validity Index (I-CVI) above the threshold of 0.70. The Scale-Content Validity Index (S-CVI) for relevance, clarity, simplicity, and ambiguity ranged from 0.9888 to 0.9966, culminating in an overall S-CVI for FingSTEv of 0.9916. Furthermore, the Kuder-Richardson Formula 20 (KR-20) value was 0.84, signifying a robust ICR among the questions (32). Detailed results for I-CVI, S-CVI, and ICR are presented in Tables II, III, and IV, respectively.

Table II: The I-CVI for Each Questionnaire Section Based on Four Criteria

Section	Relevance			Clarity			Simplicity			Ambiguity		
	Min I-CVI	Max I-CVI	Mean I-CVI	Min I-CVI	Max I-CVI	Mean I-CVI	Min I-CVI	Max I-CVI	Mean I-CVI	Min I-CVI	Max I-CVI	Mean I-CVI
A1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
A2	0.90	1.00	0.9952	0.90	1.00	0.9571	0.80	1.00	0.9619	0.80	1.00	0.9524
B	0.90	1.00	0.9960	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table III: The Overall S-CVI for Study Instrument Based on Four Criteria

$S\text{-}CVI_{Relevance}$	$S\text{-}CVI_{Clarity}$	$S\text{-}CVI_{Simplicity}$	$S\text{-}CVI_{Ambiguity}$	S-CVI FingSTEv
0.9966	0.9899	0.9910	0.9888	0.9916

Table IV: The KR-20 values of knowledge component (Section B)

Item	ICR through KR-20
Reliability coefficient	.84

DISCUSSION

Small and medium enterprises (SMEs) in Malaysia have higher accident rates than larger companies, accounting for 80 to 90 percent of reported work-related injuries from 2010 to 2012 (33). Defined as having a sales turnover of up to RM50 million or fewer than 200 employees, these businesses often overlook health and safety standards (34). This neglect significantly impacts OSH practices, resulting in financial, physical, and emotional burdens that diminish productivity and quality of life for workers. Training is essential for enhancing human capital and driving economic growth in SMEs, yet many neglect this due to weak management practices and limited resources. In 2019, only 46.1 percent of SMEs provided structured training, with merely 10.6 percent of employees receiving training—averaging just one to two sessions per year. Given the critical need for finger safety knowledge to prevent OFAI in the manufacturing sector, developing the FingSTEv alongside the FingSIM is vital. These tools address the training gap, equipping workers with the necessary skills to ensure finger safety on the job, especially for SMEs.

The absence of specific intervention modules for finger safety places SME workers at risk of injuries. This study aims to assess finger safety knowledge using FingSTEv and develop an effective intervention module for submission to the DOSH to support compliance efforts. By enhancing safety practices in SMEs, this research not only addresses OFAI but also serves as a foundation for further studies aimed at reducing workplace accidents, aligning with DOSH's Occupational Safety and Health Master Plan and strategic initiatives.

The FingSIM was developed through a multifaceted approach, incorporating secondary data analysis from JKKP8, reviews of Malaysian legislation and international guidelines, literature reviews, and expert consultations. Analyzing JKKP8 data from 2017 to 2019 identified sources of finger accidents and informed the selection of topics for the module. Prior to development, meetings with DOSH discussed aligning the module with industry needs and determining optimal delivery methods. Once the module was complete, it underwent a review by a panel of experts from DOSH who were well-versed in its content. This team, consisting of Occupational Health and Safety Officers, Occupational Health Doctors, and Occupational Health Nurses, provided invaluable insights and critiques of the draft, leveraging their extensive experience in enforcing OSH legislation and promoting safety awareness in the workplace.

FingSTEv was developed through a meticulous process, beginning with individual item creation and culminating in the formation of the overall instrument, which underwent rigorous validity and reliability assessments. Content validity was ensured by consulting diverse subject matter experts to achieve comprehensive coverage of the domain, while face validity evaluated the instrument's perceived relevance. Experts reviewed FingSTEv based on criteria of relevance, clarity, simplicity, and ambiguity, ensuring items were pertinent, easily understood, and consistently interpretable. Additionally, careful attention was paid to the design aspects, such as layout, font size, and language, to enhance readability and minimize cognitive load for respondents. This systematic approach guarantees that FingSTEv not only accurately measures the intended constructs but also contributes to the overall quality and credibility of the research findings.

Two comprehensive analyses, the I-CVI and the S-CVI, were conducted to validate the FingSTEv instrument. The I-CVI values for all items in terms of relevance, clarity, simplicity, and ambiguity ranged from 0.80 to 1.00, significantly exceeding the 0.70 threshold for suitability. The S-CVI values were as follows: relevance = 0.9966, clarity = 0.9899, simplicity = 0.9910, and ambiguity = 0.9888, resulting in a total S-CVI of 0.9916. These findings indicate that FingSTEv is thoroughly validated for accurately measuring its intended constructs. Additionally, the ICR was determined to be 0.84, demonstrating strong correlation among the questions. This high ICR value confirms that the instrument reliably measures the same underlying construct. Overall, the robust I-CVI and S-CVI results, along with the high ICR, affirm that FingSTEv is a validated and reliable study instrument, well-suited for effectively measuring the intended variables with precision.

The study investigating occupational health and safety knowledge, attitudes, and practices among healthcare workers in Accra, Ghana, developed a questionnaire based on a comprehensive literature review and insights from five experts, achieving an impressive overall face validity of 95% and an ICR of 0.87. However, it is important to note that the study did not fully adhere to comprehensive validity protocols, as it did not calculate the I-CVI and S-CVI, relying instead on average percentages for validation (35). Meanwhile, the study on the Workplace Interpersonal Problems Scale for Care Workers (WIPS) demonstrates strong reliability and validity, achieving a Cronbach's α coefficient greater than 0.75 for both total and subscale scores, along with a high ICR of 0.75 (36). Both assessments validated their effectiveness through rigorous content analysis, with the WIPS showing an item-content validity index of at least 0.90 for all items, while FingSTEv demonstrated a Kuder Richardson 20 (KR-20) value of 0.84, indicating significant ICR. These findings underscore the importance of comprehensive validity and reliability protocols for accurately measuring intended constructs for research design.

To the best of the author's knowledge, FingSTEv is the first instrument in Malaysia specifically designed to assess occupational finger safety and health. Validity considerations must include participant characteristics such as age and educational background to accurately reflect the diverse workforce. Although the instrument consists of fifty questions, which requires significant time to complete, its comprehensiveness is essential for capturing nuanced aspects of finger safety in occupational settings. Positive feedback from selected experts, chosen for their diverse expertise, affirmed the instrument's relevance, clarity, simplicity, and lack of ambiguity. This feedback indicates that each question effectively supports the study's objectives. They also highlight the instrument's robustness, despite its demanding nature.

The development and validation of FingSTEv involved rigorous steps, including expert reviews to ensure content and face validity, confirming its reliability as a tool for assessing finger safety knowledge in Malaysia. While FingSTEv can be adapted for international use due to its universal content, several limitations must be addressed. Firstly, FingSTEv is based on the specific data in FingSIM, requiring continuous updates to reflect the latest trends and causes of OFAI. Secondly, as FingSIM and FingSTEv are tailored to the manufacturing sector, modifications will be necessary for applicability in other industries, necessitating new rounds of validation. Additionally, this study focuses solely on increasing knowledge about finger safety, overlooking factors like attitudes and practices, which should be included in future research for a comprehensive understanding of occupational safety. Finally, ongoing evaluation of the long-term efficacy of pre- and post-training sessions is essential to ensure these instruments remain relevant in measuring and enhancing finger safety knowledge and practices in the workplace.

The study faced several significant limitations, primarily driven by the challenges posed by the COVID-19 pandemic. One key constraint was the selection of manufacturers and participants. Many factories contacted either declined to participate or did not respond, significantly limiting the pool of potential study sites. Even when manufacturers agreed to collaborate, recruiting participants was challenging due to reduced workforce availability during specified work periods. Moreover, positive COVID-19 cases within factories often led to temporary closures, necessitating the rescheduling of data collection efforts, which further delayed the study.

The selection of factories was geographically restricted to the Klang Valley area near Kuala Lumpur due to mobility limitations during the pandemic, which made access to other regions impractical. This constraint necessitated the use of convenience sampling instead of random sampling, potentially affecting the generalizability of the findings. Additionally, the study's focus shifted from evaluating knowledge, attitudes and practices to solely assessing knowledge. This adjustment was driven by time constraints imposed by the manufacturers and reduced working hours during the pandemic, which limited the feasibility of comprehensive data collection.

Furthermore, the reliance on self-administered questionnaires introduced the potential for response bias, as participants may have provided socially desirable answers rather than accurate reflections of their knowledge. The study’s limited time frame for follow-up testing also restricted the ability to assess the long-term impact of the intervention on participants' knowledge retention or potential behaviour changes. These limitations highlight the challenges of conducting research in a highly constrained and unprecedented environment, underscoring the need for cautious interpretation of the findings.

In summary, while the FingSTEv has demonstrated its validity and potential applicability beyond Malaysia, continuous updates and sector-specific modifications are essential for maintaining its relevance and effectiveness. Furthermore, expanding the scope to include attitudes and practices, and regularly assessing the long-term impact of training, will provide a more holistic approach to improving workplace finger safety.

CONCLUSION

The study’s key findings underscore the significant potential of FingSTEv as a robust instrument for assessing finger safety knowledge among SME workers. The results demonstrated that FingSTEv possesses strong face and content validity and reliability, ensuring its suitability for accurately evaluating workers' knowledge in this domain. These findings provide a critical foundation for developing effective safety training programs and targeted interventions aimed at reducing the incidence of OFAI in the manufacturing sector.

Moreover, this study highlights the widespread issue of finger and hand injuries, which are not only prevalent in the manufacturing industry, but also in other sectors such as construction, woodworking, automotive repair, and food processing. These industries also involve high-risk manual tasks where inadequate safety practices can lead to severe finger injuries. By identifying gaps in workers’ knowledge and highlighting areas for improvement, the study offers valuable insights that can guide both policy development and workplace safety strategies for these sectors. This impact is particularly crucial for SMEs, where resource constraints frequently limit the implementation of comprehensive safety measures. The use of FingSTEv can help prioritize and address these gaps efficiently. Beyond its application in the selected industry, the findings have broader implications for other sectors facing similar occupational risks, as they highlight the importance of tailored educational tools in fostering safer work environments.

Future research should consider integrating observational assessments of workers’ safety practices and attitudes alongside knowledge evaluations, as these factors significantly influence questionnaire responses and safety outcomes. The insights from this study not only emphasize the role of FingSTEv as a vital tool for SMEs, but also provide a template for developing similar instruments across other industries. These efforts will collectively contribute to enhancing workplace safety standards, reducing injury risks, and improving overall occupational safety and health outcomes across multiple high-risk industries.

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