Participatory Development of an Occupational Health Hazard Reduction Program in the Wood Furniture Industry

Waruntorn Jongrungrotsakul, Chawapornpan Chanprasit, Thanee Kaewthummanukul, Thomas A. Mackey

Abstract: The purpose of this participatory action research was to develop and evaluate an Occupational Health Hazards Reduction Program in the wood furniture industry. Research participants included 83 workers, the owner of a wood furniture factory, and an occupational health nurse responsible for worker health in San Kam Phaeng District in Chiang Mai Province, Northern Thailand. The study involved two main phases: 1) collaboratively developing and implementing the Program and an action plan with participants, and revising the plan until the Program was appropriate for the work context; and 2) evaluating Program implementation, by using the *Workplace Hazards and Safety-based Behaviors Questionnaire*. Data were analyzed using descriptive statistics and Chi-Square test.

The Program, collaboratively developed by the participants and the researchers, and consisted of: 1) interactive safety training on building the capacity of lead workers to communicate the importance of using personal protective equipment; and 2) establishing and posting safety rules and regulations in work areas. An evaluation of program effectiveness was performed at weeks 8 and 16 following program implementation. Results indicated that the personal protective equipment use significantly increased from baseline ($p<.01$), and that a collaborative effort involving management and workers was effective in reducing risk and increasing safety-based workplace behaviors. Collaborative efforts created a sense of 'ownership' and 'partnership' by working together. We conclude that a participatory approach can be used by occupational health nurses and health and safety workers to resolve similar or different occupational health problems in other wood factories.

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Introduction and Background

Small and medium-sized enterprises (SMEs) comprise a significant proportion of the global economy in both industrialized and developing countries,[1,2] however working environments and conditions at SMEs are substandard or worse than that of larger enterprises.[3] Wood furniture production is one of the most hazardous industries recognized by the Thailand International Labor Organization (ILO).[4]

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In Northern Thailand, the majority of such manufacturing takes place at SMEs and it is well-documented that the working environment and conditions are unsafe and dangerous.[5,6] A preliminary situational analysis of occupational health problems in a medium-sized wood industry in Chiang Mai Province[7], documented significant occupational health hazards such as excessive noise, and extreme amounts of wood dust (100%), awkward postures and repetitive movements (98.8%). The situational analysis also documented unsafe working conditions such as working with sharp equipment and obstructed work areas (100%). Moreover, noise levels were measured at 91.2-98.7 decibels(A), which exceed the occupational noise exposure limit of 85 decibels (A) for an 8-hour time period. The most common work-related illnesses and injuries resulting from hazard exposures included musculoskeletal disorders such as low back/waist/ body pain (87.9%), respiratory irritation (78.3%), tinnitus or hearing problems (68.7%), and non-fatal work-related injuries such as traumatic impact/ collisions (91.6%) and abrasions (74.7%). According to this assessment, the workers were at high risk to incur work-related illnesses and injuries due to unsafe working environment and conditions.[8]

Previous studies identified that 85-88% of all work-related injuries were caused by unsafe worker behaviors.[9,10] Unsafe behaviors included failure to use personal protective equipment (PPE), and not following safety instructions or regulations.[11,12] The preliminary situational analysis demonstrated low PPE use.[7] The majority of workers never wore protective gloves (96.4%), safety shoes (92.8%), or earplugs (86.7%). Markedly, only 3.6% of workers always wore a mask when exposed to wood dust. In terms of worker safety practices, the majority of workers had never checked their equipment before use (96.4%), used a cart/trolley to move heavy objects (85.5%), or checked electrical and ground wires before operating machinery (84.3%).[7] Studies in Thailand showed that 33.3-48.9% of work-related injuries were caused by a failure to use PPE or by breaking safety rules and regulations.[13,14] Hence, to prevent illnesses and injuries work-related, health professionals must place greater importance on implementing preventive measures to reduce occupational health hazards (OHH), unsafe work conditions, and unsafe behaviors of workers.

Preventive measures commonly used include three main strategies: engineering controls, enforcement, and education.[15,16] Engineering control are built into the design of a new plant or equipment to minimize the risk of exposure to hazardous machinery. Engineering controls are accepted as the most effective method, but are not practical for SMEs due to the high costs and the initial investment required.[17] Enforcement refers to establishment of safety rules and regulations in the workplace. National safety regulations generally apply to only large enterprises in Thailand and do not include SMEs. However, large enterprises do not rely on regulation alone, but enforce and encourage safety behaviors through other methods such as education and training.[16] Education concerns the provision of occupational health and safety information to workers through safety training with the aims of increasing knowledge and assisting workers in adopting safety-based behaviors.[18] Education is widely used as a preventive measure in many workplaces due to the low investment required and its cost effectiveness.[19] However, safety training in SMEs has not garnered much attention compared to large enterprises due to the lack of regulations.[20] Therefore, education and safety training, which is a vital role for occupational health nurses, is a critical preventive measure to reduce work-related illnesses and injuries.

Effective safety training to promote safety-based behaviors in the workplace requires workplace health promotion strategies, including awareness, behavioral modification, and a supportive environment.[21,22]

Awareness involves communicating information related to occupational risks or hazards with the intention of enhancing individual knowledge levels. It is also important to simultaneously reinforce the adoption of safety-based behaviors while creating a supportive environment (such as organizational culture or regulations) that encourages sustained safety-based behaviors.[21,22,23] Evidence suggests that food safety awareness training significantly increased knowledge of hand washing among Hispanic workers in the mushroom industry and a supportive environment (in which food safety rules were enforced) significantly increased hand washing behaviors before work or after breaks.[24] Hence, an occupational health program aimed at reducing work-related illnesses and injuries should target awareness, behavioral modification, and creating a supportive environment. Based on the literature, however, most available existing interventions in the workplace have focused solely on either raising awareness or behavioral modifications. Some interventions focused on both, whilst very few interventions also stressed creating a supportive work environment.[25,26] Furthermore, these interventions lacked participation from either the employer or employee, a critical factor in sustaining behavioral modification when making the change from unsafe behaviors to safety-based behaviors.[27]

To achieve sustainable development of an occupational health and safety (OHS) program in the workplace, high level stakeholder involvement, including employer, workers, and health care providers, must be employed.[27] Such involvement enhances a sense of ownership and partnership in developing workplace health program among workers, and employers and management can also feel ownership of the program.[3,28] Empowerment can encourage stakeholders to collaboratively take part in formulating the workplace health program. Empowerment begins with problem identification, program planning, implementation, and evaluation.[27] Previous studies indicated that interventions that included the participation of employers and workers reduced exposure to heat, dust, and noise in small enterprise work environments in developing countries.[5,6,8] Burantrevedh & Sweatsriskul's study also showed that collaboration between farmers and local student-teacher networks used biological methods to create a sustainable model to promote farmer' health and prevent exposure to pesticides.[29] This evidence suggests that stakeholder involvement is a critical ingredient of a sustainable program aiming to reduce OHH hazards in many industries.

Study Background

In view of the above, a participatory action research (PAR) approach was used to cultivate collaboration between the first researcher, employer, workers, and health care providers in the community, and to undertake a study in a medium-sized wood furniture factory in San Kam Phaeng District, Chiang Mai Province, Northern Thailand[7]. The initial phase involved a situational analysis of occupational health problems in the wood furniture industry but this analysis is only briefly discussed here as background context. This paper focuses mainly on the second and third phases of the study: the collaborative process for program development, and an evaluation of program implementation as shown in **Figure 1**.

Objectives

Study objectives were to: 1) develop a program to reduce OHH in a wood furniture factory in Northern Thailand; and 2) evaluate the outcomes of program implementation.

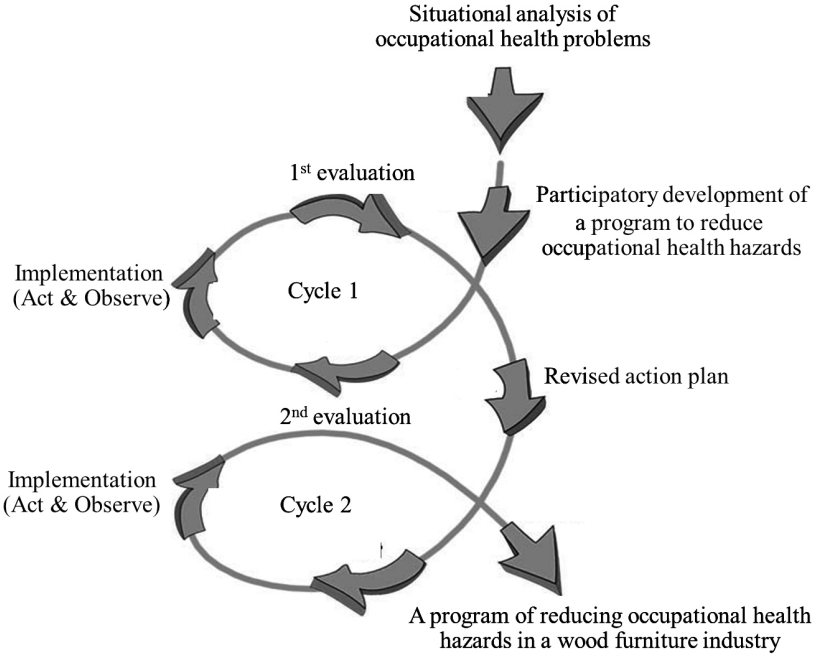

Figure 1 A cycle of PAR procedure

Methods

Design: This study used a participatory action research (PAR) approach, focusing on empowering worker participants to develop a collaborative program to reduce OHH. The full study was comprised of three phases: 1) situational analysis of occupational health problems, in-depth interviews with the factory owner and an occupational health nurse, and focus group discussions and interviews with workers; 2) collaboratively developing and implementing a program of reducing OHH between participants and the researcher, including revising the plan until the program was appropriate for the work context; and 3) evaluating the program implementation by using a workplace hazards and safety-based behaviors questionnaire. Phases 2 and 3 are addressed in this paper.

Ethical Considerations: Approval for this study was obtained from the Institutional Review Board, Faculty of Nursing, Chiang Mai University. Research background, objectives, and procedures were described to participants, who gave written consent to participate. Participants were also informed that they were free to withdraw from the study at any time without penalty.

Participants: Three groups were recruited for study participation: the factory owner, all 83 woodworkers and woodcarvers (hereafter 'workers') in the factory, and an occupational health nurse working in the community hospital in San Kam Phaeng District, Chiang Mai Province where the factory was located. Of the 83 workers who participated in all three phases of the study, 15 were recognized as 'lead workers' based on consensus from the factory owner and other workers. Lead workers played a central role, working closely with the researchers throughout the entire PAR process as co-researchers collaboratively developing and implementing the program, as well as reflecting on, and evaluating desirable outcomes following program implementation.

Data collection. Data were gathered through a *Workplace Hazards and Safety-based Behaviors Questionnaire* (WHSBQ) developed by the research team to measure safety-based behaviors at baseline, 8 weeks, and 16 weeks after implementing the program. The WHSBQ contained 26 items in total, and two examples of these are: "Do you use a mask when exposed to wood dust?" and "Do you use earplugs when exposed to excessive noise?" Responses were based on a rating scale of three points and possible response categories were: never, sometimes, and always. Content validity was assessed by a panel of five experts qualified in occupational and environmental health. The content validity index was 0.91 for woodworkers, and 0.93 for woodcarvers. The reliability of the WHSBQ was tested on 20 workers (ten woodworkers and ten woodcarvers) in a wood furniture factory similar to that of the research setting, but they were not participants in the large study. The internal reliability was 0.80 for woodworkers and 0.82 for woodcarvers.

Data analysis. Data were analyzed using descriptive statistics and Chi-Square test.

PAR Process

PAR processes enabled the empowerment of participants (workers) to develop a program to reduce OHH in their setting. Moreover the PAR approach greatly enhances collaboration and allows participants to take part in the research process as 'partners'.[22]

1) Program development. This phase involved collaborative development, implementation, and revision of a plan to reduce health hazards and risks by the participants and the researchers.

Developing the action plan. In the initial phase, the situational analysis identified specific workplace hazard problems and risks which included: excessive noise, vibration, wood dust, adhesives/chemicals, awkward working postures, repetitive tasks, sharp equipment, tools placed in disorderly fashion, obstructed work areas, and low rates of PPE use among workers. Data from the situational analysis were presented to participants to allow them to prioritize which issues to focus on in the program. They were encouraged to share their opinions and to give suggestions until consensus was reached. The participants' primary concern was reducing and avoiding excessive noise or wood dust in the work environment. These issues became the focus of the action plan. It was agreed that promoting use of PPE was feasible. Lead workers acknowledged that it was appropriate for them to teach or educate co-workers on how to wear PPE to prevent noise and wood dust exposures, however they lacked knowledge on how to teach co-workers to wear the PPE correctly. An interactive safety training workshop was developed to train lead workers in their teaching roles. The researcher, occupational health nurse, and a participant were responsible for developing safety training course content.

Implementation: A one-day interactive safety training workshop aimed at increasing workers' knowledge about correct PPE use was conducted by the nurse and researchers. This workshop consisted of three sessions: workplace hazards in the wood furniture factory, safety-based behaviors, and communication skills aimed at reducing risk. The training utilized adult education principles including lecture, group discussion, demonstration and participant demonstration. Following the training, the lead workers developed supplementary teaching material to help them better to educate their co-workers on how to correctly use PPE. Education was given onsite to groups or individuals depending on the preference of each lead worker.

Action plan revision. Since the training alone was not considered fully effective in encouraging co-workers to adopt consistent PPE use, lead workers revised the action plan during week 8 after the safety training. The revised plan included the addition of safety rules and regulations along with posting safety signs in the workplace so as to create a supportive environment and encourage continuous PPE use.

2.) Program evaluation. To assess the success of the action plan, data was collected to evaluate desirable outcomes and PPE use at two time points. The first evaluation was conducted at week 8 following the health education conducted by lead workers, and the second evaluation, week 16 after the action plan revision.

Findings

As mentioned above the findings presented are only for the second and third phases of the study and are divided into two main parts: 1) presentation of our developed Model and 2) evaluation of effectiveness of program implementation.

Model of Occupational Health Hazards Reduction Program (OHHRP or the Program): The OHHRP is comprised of three essential components: interactive safety training, establishment of safety rules and regulations, and posting of safety signs at work (**See Figure 2**).The safety training stresses building capacity of lead workers to understand workplace hazards and its associated adverse health effects, to communicate risks in their workplace, and to correctly use PPE. The establishment of safety rules and regulations focuses on consistent PPE use when exposed to hazards, creating an orderly work area, promoting safe work practices, and strictly following lead workers' suggestions regarding safety at work. During the PAR the posting of safety signs in the workplace helped to create a supportive work environment and were a reminder to workers that the consistent PPE use was the desired outcome of the program.

Effectiveness of program implementation. As shown in **Table 1**, study findings revealed that safety-based behaviors of workers significantly increased at weeks 8 and 16 ($p<.01$). When comparing baseline PPE use with later weeks, the use of masks increased from 3.6% at baseline to 66.3% at week 8 and 78.3% at week 16, while the use of earplugs increased from 0% at baseline to 75.9% and 80.7% at weeks8and 16, respectively. With regards to PPE maintenance, replacement of damaged PPE increased from 8.4% at baseline to 44.6% at week 8 and 54.2% at week 16, while cleaning PPE after use increased from 7.2% at baseline to 30.1% and 32.5% at week 8 and 16, respectively.

I. Interactive safety training

II. Establishment of safety rules and regulations

III. Posting safety signs at work area

Figure 2 Three Components of OHHRP or the Program

Table 1: Percentage of workers who reported always using personal protective equipment (n=83)

Safety-based behaviors	baseline n(%)	8 weeks n(%)	16 weeks n(%)	χ^2	p-value
PPE use					
masks	3(3.6)	55(66.3)	65(78.3)	26.61	.000
earplugs	0(0)	63(75.9)	67(80.7)	31.34	.000
long-sleeved shirt/pants	2(2.4)	58(69.9)	60(72.3)	16.49	.000
safety glasses	0(0)	37(44.6)	38(45.8)	22.27	.000
safety shoes	2(2.4)	28(33.7)	35(42.2)	75.19	.000
PPE maintenance					
inspecting PPE before use	5(6.0)	8(9.6)	16(19.3)	31.34	.000
replacement of damaged PPE	7(8.4)	37(44.6)	45(54.2)	57.36	.000
cleaning PPE after use	6(7.2)	25(30.1)	27(32.5)	60.73	.000

Discussion

Our findings indicate that the OHHRP successfully improved safety-based behaviors among workers when baseline evaluation data was compared to that at two time points after the education/training occurred. We believe that the key factor that contributed to this success was the full participation and involvement of the stakeholders in the program and PAR processes. Moreover, collaboration between the first researcher and lead workers created a sense of program ownership which motivated lead workers to be actively involved in all stages of the PAR process including problem identification, planning, implementation, and evaluation of the action plan.[35] Active involvement of lead workers also demonstrated the role of empowerment in allowing lead workers to take control over OHH. Various reports on occupational health risk reduction processes at different workplaces confirm this relevance, as participation and empowerment are crucial aspects in workplace health promotion programs.[36] For example, participatory methods were effectively applied to reduce OHH in small workplaces in at least two studies[37,38] where the researchers played crucial roles in facilitating and supporting participants' initiatives in participatory solving of occupational health problems.[38] Kogi [39] also found that participation of workers was essential for successful resolving of ergonomic issues in the workplace. Involvement of workers in planning and controlling significant aspects of their work, along with sufficient knowledge and power to influence both processes and outcomes made it possible for them to achieve their desire goals. The empowering nature of PAR also allows lead workers to have "ownership" of the program and the researcher was accepted as a partner in the process.[36] Full participation results in a sense of ownership among participants, reduces dependency on others to solve existing problems, and ensures sustainability of programs that respond to local needs. Ownership can mean a range of things in different contexts. For lead workers, it could mean moving from being mere participants in a study or program to becoming key persons in decision-making[40].

In this study, strategies of a workplace HP program such as awareness, behavioral modification, and providing a supportive environment were applied to reduce OHH by promoting safety-based behaviors of workers. Lead workers were trained through interactive safety training which adopted adult education principles. Lead workers were trained to be peer educators who could communicate health risk information. This enables workers to change unsafe behaviors, including failure to use PPE when exposed to OHH in the workplace. The training was successful in increasing workers' awareness of workplace hazards, the consequences of exposure to hazards, as well as the importance of using personal protective equipment. These findings are in line with findings of a previous study.[23] Establishment of safety rules and regulations, to complement the information in the training reinforced what they learned and provided additional support and encouragement to engage in safety-based behaviors—which is consistent with other studies.[31,33] In addition, posting safety signs to create a supportive environment in the workplace helped workers maintain consistent and correct use of personal protective equipment, which is also supported by findings from other studies.[32,34]

Obtaining the support of the factory owner was crucial for success as this person supported program implementation by providing resources, such as meeting space for training as well as other necessary facilities to support this study. Owners' support helps make implementation of a program progress smoothly to a successful conclusion.[37] Similarly Liang *et al.*[38] found that employer or top management support are key to effective implementation of evidence-based workplace HP initiatives to reduce modifiable health risk behaviors among workers.

Conclusions and recommendations

The participatory approach used in this OHHRP confirmed the importance of building capacity among lead workers to solve OH&S problems on their own. Stakeholder involvement in problem solving is required for creating a successful program in the workplace through safety-based behaviors. Such involvement creates a sense of 'ownership' and 'partnership' of working together. Further study is needed to test the effectiveness of program implementation to reduce OHH in various settings as well as the process of program implementation. Our Program should be further developed and applied to other occupational health problems such as reducing work-related injuries among workers in a number of settings. It is also recommended that occupational health professions should conduct ongoing health risk surveillance among wood furniture workers to document any ill health effects resulting from exposure to health hazards. Such surveillance should be implemented systematically and regularly to maximize optimal health among workers.

Limitations of the study

The findings of this study in a wood furniture factory in Chiang Mai Province, may not be generalizable to other settings. However, we believe that occupational health nurses and health care providers in the community can adopt participatory approaches with success in resolving occupational health problems, particularly using safety-based behavior modification in other wood furniture factories. Moreover, future studies should build into their design evaluation of learning from interactive safety training over a longer time period, for example, six months or one year after program conclusion. This will hopefully provide evidence of the longevity of changed workplace safety-based behaviors among workers.

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การพัฒนาและการประเมินผลโปรแกรมการลดปัจจัยคุกคามสุขภาพจากการทำงานในอุตสาหกรรมเฟอร์นิเจอร์ไม้

วรันธรณ์ จงรุ่งโรจน์สกุล, ชวพรพรรณ จันทร์ประสิทธิ์,ธานี แก้วธรรมานุกูล, Thomas A. Mackey

บทคัดย่อ: การวิจัยเชิงปฏิบัติการแบบมีส่วนร่วมครั้งนี้มีวัตถุประสงค์เพื่อพัฒนาและประเมินผลโปรแกรมการลดปัจจัยคุกคามสุขภาพจากการทำงานในอุตสาหกรรมเฟอร์นิเจอร์ไม้ ผู้ร่วมวิจัยประกอบด้วย คนงาน จำนวน 83 คน เจ้าของสถานประกอบกิจการโรงงานเฟอร์นิเจอร์ไม้ และพยาบาลอาชีวอนามัยที่รับผิดชอบดูแลสุขภาพคนงานในเขตพื้นที่อำเภอสันกำแพง จังหวัดเชียงใหม่ กระบวนการวิจัยเชิงปฏิบัติการแบบมีส่วนร่วมประกอบด้วย 2 ขั้นตอนหลัก คือ 1) การพัฒนาและดำเนินการตามโปรแกรมการลดปัจจัยคุกคามสุขภาพจากการทำงานร่วมกับผู้ร่วมวิจัย ตลอดจนปรับเปลี่ยนแผนดำเนินการจนได้โปรแกรมที่เหมาะกับบริบทการทำงานของสถานประกอบกิจการ และ 2) การประเมินผลการดำเนินโปรแกรมโดยใช้แบบสัมภาษณ์ปัจจัยคุกคามสุขภาพจากการทำงานและพฤติกรรมการทำงานที่ปลอดภัย วิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณนาและการทดสอบไคสแควร์

โปรแกรมการลดปัจจัยคุกคามสุขภาพจากการทำงานที่พัฒนาขึ้นจากความร่วมมือระหว่างผู้ร่วมวิจัยและผู้วิจัย เน้นการใช้อุปกรณ์ป้องกันอันตรายส่วนบุคคล ประกอบด้วย 1) การจัดอบรมความปลอดภัยเชิงปฏิสัมพันธ์ มุ่งสร้างศักยภาพหัวหน้าคนงานในการสื่อสารถึงความสำคัญของการใช้อุปกรณ์ป้องกันอันตรายส่วนบุคคล และ 2) การสร้างพร้อมติดป้ายกฎระเบียบข้อบังคับในบริเวณที่ทำงาน การประเมินผลประสิทธิผลของโปรแกรม ดำเนินการในสัปดาห์ที่ 6 และสัปดาห์ที่ 8 ผลการประเมินพบว่า คนงานใช้อุปกรณ์ป้องกันอันตรายส่วนบุคคลเพิ่มขึ้นจากก่อนดำเนินโปรแกรมอย่างมีนัยสำคัญทางสถิติ ($p<.01$) ผลการศึกษาครั้งนี้ชี้ให้เห็นว่า การลดความเสี่ยงจากการทำงานและเพิ่มพฤติกรรมการทำงานที่ปลอดภัยในสถานประกอบกิจการ จำเป็นต้องอาศัยความร่วมมือระหว่างสถานประกอบกิจการและคนงาน สร้างความเป็น “เจ้าของ” และ “หุ้นส่วน” ของการทำงานร่วมกัน พยาบาลอาชีวอนามัยสามารถประยุกต์ใช้กระบวนการมีส่วนร่วมในการแก้ไขปัญหาอาชีวอนามัยในอุตสาหกรรมผลิตเฟอร์นิเจอร์ไม้แห่งอื่น

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คำสำคัญ: ปัจจัยคุกคามสุขภาพจากการทำงาน อุตสาหกรรมเฟอร์นิเจอร์ไม้การวิจัยเชิงปฏิบัติการแบบมีส่วนร่วม อาชีวอนามัยและความปลอดภัย

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