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Understanding and fixing WMSDs in herbal medicine workers at Luang Por Poen Hospital, Thailand

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ABSTRACT

Work-related Musculoskeletal Disorders (WMSDs) affect millions globally, involving painful conditions of muscles, tendons, ligaments, and nerves due to workplace factors like repetitive tasks and awkward postures. Common ergonomic risks include repetitive tasks, awkward postures, forceful exertions, and prolonged static positions. A program at Luang Por Poen Hospital in Thailand educated workers in the Herbal Medicines division on WMSDs, with management support. The program provided education on WMSDs to workers and management, with strong support from company leadership. Workers were instructed to perform muscle stretching exercises before, during, and after work, and to continue these exercises at home. Over a month, supervisors observed workers' stretching routines. The Nordic Body Map Index (NBMI) was used to assess pain; workers reported pain in various body regions. Severe neck pain decreased from six workers to one, and severe back pain from three workers to none. However, severe shoulder pain remained unchanged. No workers reported severe pain in the arm, back, buttock, wrist, calf muscle, or ankle after the program. In conclusion, incorporating stretching into the work routine benefits workers by improving physical health, mental well-being, and productivity. Encouraging regular stretching and providing opportunities for stretching breaks can create a healthier, more ergonomic work environment.

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1. INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) are conditions that affect the muscles, tendons, ligaments, nerves, and joints due to work-related activities. These disorders can cause pain, discomfort, and reduced mobility, and may lead to long-term disability if not properly managed. WMSDs commonly affect the upper limbs (such as the neck, shoulders, arms, and hands), as well as the lower limbs (including the lower back, hips, knees, and feet) (Lee et al., 2023). The prevalence of WMSDs underscores their impact on individuals, workplaces, and society as a whole. These disorders not only cause physical discomfort and limitations but also lead to decreased productivity, increased healthcare costs, and reduced quality of life for affected individuals. Understanding the causes, risk factors, and consequences

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of WMSDs is crucial for implementing effective prevention strategies and promoting worker well-being (Soares et al., 2019).

Common types of WMSDs include carpal tunnel syndrome, tendonitis, epicondylitis, rotator cuff injuries, lower back pain, and neck pain (Nunes & Bush, 2012). WMSDs can happen when there is a mismatch between the physical capabilities and limitations of workers and the demands of their job tasks. These disorders typically occur due to repetitive motions, awkward postures, forceful exertions, prolonged sitting or standing, or other ergonomic risk factors present in the workplace. WMSDs can affect various parts of the body, including the muscles, tendons, ligaments, nerves, and joints (Chinedu et al., 2020).

WMSds are commonly experienced when you start a new workout routine or increase the intensity of your activities. WMSDs are believed to be caused by microscopic damage to muscle fibres, particularly during the eccentric (lengthening) phase of muscle contraction (Nishikawa et al., 2018). So that triggers an inflammatory response in the affected muscles. This response involves the release of various chemical mediators, including prostaglandins, cytokines, and histamines, which contribute to pain and swelling. While it can be uncomfortable, it's usually not a cause for concern and tends to resolve on its own within a few days (Hody et al., 2019). WMSDs can cause a variety of pain symptoms depending on the specific condition and affected area of the body (Da Costa & Vieira, 2010). Such as localized pain that is typically felt at the site of the injury or strain. It can manifest as aching, soreness, tenderness, or discomfort in muscles, tendons, ligaments, or joints. Some WMSDs may cause sharp or stabbing pain, especially with certain movements or activities. This type of pain can be sudden and intense, often indicating tissue irritation or inflammation (Barr et al., 2004). Furthermore, chronic WMSDs may cause a persistent dull, aching pain that worsens over time or with repetitive tasks. This type of pain may be more diffuse and can affect larger areas of the body. Nerve compression or irritation associated with WMSDs, such as carpal tunnel syndrome, may lead to burning or tingling sensations along the affected nerve pathways. This can also include numbness or "pins and needles" sensations (Rempel et al., 1999; Szmyd et al., 2022). Unfortunately, another condition is that some WMSDs can cause pain that radiates from the primary site of injury to nearby or distant areas. For example, a herniated disc in the lower back may cause radiating pain down the leg, known as sciatica (Hossain et al., 2018). WMSDs also give pain with movements, pain in rest, referred pain and muscle spasms. So that, it's essential to address pain associated with WMSDs promptly to prevent the worsening of symptoms and potential long-term disability. Treatment typically involves a combination of rest, physical therapy, ergonomic modifications, pain management techniques, and in some cases, medical interventions such as medications or surgery (Lee et al., 2021).

WMSDs can happen when there is a mismatch between the physical capabilities and limitations of workers and the demands of their job tasks. These disorders typically occur due to repetitive motions, awkward postures, forceful exertions, prolonged sitting or standing, or other ergonomic risk factors present in the workplace (Hossain et al., 2018). Factors that contribute to the development of WMSDs include repetitive movements, awkward postures, forceful exertions, prolonged sitting or standing, poor ergonomics, lack of Rest and recovery and individual factors (age, fitness level, underlying health conditions, and previous injuries) (Soares et al., 2019).

WMSDs can have significant effects on both individuals and organizations (companies). Pain and discomfort stiffness, and reduced mobility in affected body parts, such as the back, neck, shoulders, arms, or hands. These symptoms can range from mild to severe and may interfere with daily activities both at work and at home. Chronic WMSDs can significantly impair an individual's quality of life by limiting their ability to perform tasks, participate in recreational activities, and enjoy leisure time without pain or discomfort. Also, WMSDs can lead to decreased work productivity due to discomfort,

pain-related distractions, reduced efficiency in completing tasks, and the need for frequent breaks or accommodations to manage symptoms (Albanesi et al., 2022).

Luang Por Poen Hospital at Nakhon Pathom, Thailand is located in the peripheral city of Salaya, Nakon Pathom, Thailand. This hospital is a multi-division hospital that provides health services to people and also has a division that makes herbal medicines, especially Thai medicine. This hospital is one of the collaborative partners of the Faculty of Physiotherapy, Mahidol University Thailand. The physiotherapy team from the Muhammadiyah University of Surakarta collaborated with the physiotherapy team from Mahidol University to carry out joint activities to assess the health quality of the herbal medicine manufacturing workers in terms of ergonomics and duration of work. This activity is a form of international cooperation that has been established between the two universities, to mutually understand the conditions of their respective target communities and provide their role to the people in those communities. This hospital is an example or role model for how a hospital can become a good community setting where physiotherapists play a role in it. This hospital has superior Intermediate Medicine which integrates Physiotherapy, Occupational Therapy, and Chinese Medicine, especially for Thai and Chinese medicine. With this collaboration, patients receive comprehensive service. So that the patients get maximum results. Hospitals teach us how multidisciplinary professional collaboration has an important role in improving the quality of life of patients. Where the spirit of collaboration between professions is the core value of community services.

The problem faced in Luang Por Poen Hospital is the workers who mix and make Thai and Chinese herbal medicines. Manufacturing still uses conventional equipment from planting herbal plants to producing herbal medicines. Herbal medicine making activities start from Herbal medicine-making activities start as follows.

Planting of Herbal Plants by Farmers in Hospital Plantations

During the planting phase of herbal plants, farmers are very at risk of injury to the back area. Due to the static bending position and long periods (repetitive injury). As shown in Figure 1.

Selection of Herbs that have been Harvested to be Processed into Medicine (Ingredient Verification)

At this stage, the worker sits for about 8 hours in front of a large box containing the farmer's harvest. Workers sit down to select the best crops to continue with the drug production process. This stage will involve static positions for a long duration, especially in the muscles of the back, tailbone, buttocks, neck and shoulders. Musculoskeletal muscle problems at this stage are often referred to the rehabilitation clinic (physiotherapy) with complaints of back, neck and shoulder pain. As shown in Figure 2.

Herbal Medicine Production Stages (Manufacturing and Extraction)

In this part, there are some parts about making the medicines, as well: (1) At this stage, the workers have to stand back and forth checking the production machine, occasionally bringing ingredients (herbal ingredients, oils to increase concentration and medicinal aromas) and checking the temperature of the machine. Workers complain of knee and back pain in this division. As shown in Figure 3; (2) Stages of making pills using conventional machines. Workers have to stand and mix the herbs for the machines to grind. The standing stage lasts between 6-8 hours with a 15-minute rest period. In this position, there

will be musculoskeletal stress on the waist and lower extremities. As shown in Figure 4; (3) At this stage, workers have to sit for almost 8 hours to pack the herbal medicine and make it ready to be marketed. Musculoskeletal disorders often occur in the shoulder, neck and waist areas. As shown in Figure 5.

Figure 1. Planting of herbal plants
Figure 2. Selection of herbs

Figure 3. Checking in the production machine
Figure 4. Making pills using conventional machine
Figure 5. Pack the herbal and ready to sell

The activities of these workers unknowingly trigger the emergence of WMSDs. WMSDs are a condition that disrupts the quality of work because the workers complain about muscle pain when they work. So that, workers will take frequent holidays from work. This will reduce production and increase expenditure on medical treatment for workers by the management of hospitals. WMSDs are a familiar condition in the production environment, but in general, the WMSDs problem is ignored. After various worker health problems emerged and increased in number, production management began to find out how to reduce morbidity due to workload. Luang Por Poen Hospital has established good collaboration with the Faculty of Physiotherapy, at Mahidol University. Therefore, this collaboration activity aims to provide knowledge about WMSDs to workers and hospital management, so that knowledge about WMSDs increases among them. Another aim is to provide education and ways to stretch muscles that are overworking so that these muscles can still work according to their limits and WMSDs do not occur. If production management understands WMSDs and the dangers of WMSDs, then the education program provided to workers will receive full support from production management.

2. METHODS

This collaborative activity has received approval from the Faculty of Health Sciences, Muhammadiyah University of Surakarta with number 109.22/A.3-III/LPMPP/VII/2023, and from the Faculty

of Physiotherapy, Mahidol University Thailand with number 109.345(7.4)/055. The two universities have coordinated through Zoom meetings and prepared activity programs together. Collaborative activities at Luang Por Poen Hospital were done for 1 month. Where, for 2 weeks, they were monitored directly by the team from both universities, and the following 2 weeks were coordinated via Zoom meetings. However, a team from Mahidol University always came to monitor the education, whether it was done according to the schedule and procedures or not.

This collaborative activity aims to reduce WMSDs, improve workers' physical health, and increase worker productivity. WMSDs complaints were evaluated using the Nordic Body Map Index (NBMI). The NBMI could potentially refer to a scoring system or an aggregated measure derived from the responses collected using the NBMI. The NBMI itself is a simple diagram where individuals can mark areas of their body where they are experiencing pain or discomfort. It typically divides the body into different regions, such as the neck, shoulders, back, arms, and legs. The NBMI is a tool used in occupational health and safety to assess and document musculoskeletal discomfort or pain experienced by workers.

The NBMI, however, might refer to a quantitative measure derived from the data collected using the NBMI (Adiyanto et al., 2022). The NBMI was noted to have a good agreement for pain over the last 12 months and 7 days (80 percent vs. 79.7 percent). As well, as well as good sensitivity and a high specificity for all body areas, there are 60.9 percent and 89.1 percent respectively. However, considering pain in the last 7 days, it has high sensitivity (85.1 percent) and specificity for all areas of the body (70.1 percent) (Mendonça et al., 2018). The primary function of the NBMI is to assess the prevalence and severity of musculoskeletal discomfort or pain among workers (Hamberg-van Reenen et al., 2008). This index provides a structured way to document the location and intensity of discomfort experienced in various body regions. It can be used also to identify the high-risk areas to develop WMSDs, By analysing the data collected through the NBMI, employers and occupational health professionals can identify high-risk areas or tasks within the workplace that are associated with a higher incidence of musculoskeletal discomfort. This information can inform targeted interventions to reduce ergonomic risk factors and prevent injuries (Dovjak & Kukec, 2019).

This collaboration activity consists of several stages, including: (1) Job analysis for workers by teams from UMS and MU; (2) Carry out WMSDs analysis on workers using NBMI; (3) Each worker writes their name, division name, how long they work in a day, how much work experience they have, and the type of disability they suffer. The pain felt in that part of the body is shaded/marked with the painful part of the body and a cross on the letters A, B, C or D. This Nordin body map will be used by officers to identify problems in each division and formulate appropriate training according to the area of pain which can be done before work, during work (work interval) and after work; (4) Explain the results of the analysis to production management; (5) Provides an overview of pain in body regions complained of by workers; (6) Provide an understanding of the muscle pain felt by workers; (7) Provide knowledge about WMSDS to workers and production management; (8) Providing solutions to reduce complaints of muscle pain in workers; (9) Provide education in the form of muscle stretching/body movements aimed at reducing and avoiding continuous WMSDS; (10) Provide direction to workers to repeat movements that have been taught at home, and at work (before, during and after work); (11) The movements (movement exercises) given are shown in Figure 7. Exercises are carried out for the upper and lower extremities. Each movement is done in 2 settings, each setting 8 repetitions; (12) Stop working when muscle pain appears, and immediately stretch the muscles; (13) Ask the workers to do not to stay in a static position for more than 15 minutes, if more than that, immediately move their body.

Exercise is adopted from the World Journal of Orthopedics for people with limitations (Musumeci, 2015). The exercise was given by education that workers must do according to the schedule. The

program provided education and implementation of movement and function exercises to prevent musculoskeletal disorders. Workers are asked to do the movements like in picture 7 every day, while at home, before, during and after work. This education is known to production management and they understand the benefits so they support this activity. The NBMI were used to evaluate WMSDs in pre and post-education. We concluded the sum of workers complained of WMSDS in every part of the body with the criteria A = No Pain; B = Pain; C = Moderate Pain; and D = Severe Pain.

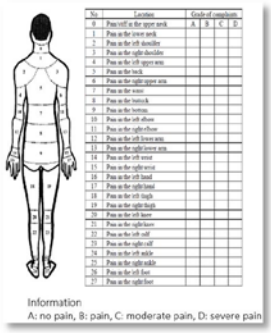

Figure 6. Nordic body map index
Figure 7. Forms of exercise or stretching for workers

3. RESULTS AND DISCUSSION

The results of the Nordic Body Map Index before and after education are described in Table 1.

Table 1. Nordin Body Map Index (NBMI) before and after treatment

Pain location	No Pain (1)		Pain (2)		Moderate Pain (3)		Severe Pain (4)		Total
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	
Neck	0	0	7	7	11	16	6	1	24
Shoulder	0	0	9	11	9	7	6	6	24
Arm	3	3	12	13	6	8	3	0	24
Back	0	0	12	15	9	9	3	0	24
Elbow	4	9	12	9	4	3	4	3	24
Buttock	4	0	13	22	4	2	3	0	24
Wrist	2	5	14	13	5	6	3	0	24
Fingers	0	4	16	14	4	4	4	2	24
Thigh	0	5	18	15	6	4	0	0	24
Knee	0	2	14	12	4	7	6	3	24
Calf muscle	0	0	11	9	11	15	2	0	24
Ankle	2	5	14	19	6	0	2	0	24
Foot	7	10	15	14	2	0	0	0	24

There were 24 workers taking part in this program, who came from the herbal medicine delivery administration division, farmers (planting herbal medicinal plants), sorting (selecting harvest) and production divisions. Table 1 explains the decrease in NBMI scores in herbal medicine workers at Luang Por Poen Hospital. Movement education carried out at Luang Por Poen Hospital showed a positive impact on reducing WMSDs complaints. There are 2 body regions, namely the neck and shoulders, which have no number of workers without complaints. Most of the workers complained of moderate pain in the area. The workers who had severe pain in the neck showed a significant reduction, from 6 workers to 1 worker. Also, workers with "moderate pain" complaints in neck regio show reduced dramatically (67 percent to 25 percent). However, the "severe pain" complaint in the shoulder did not reduce at all. There was no decrease in the number of workers who complained of the "pain" category before and after education in the neck area. A significant effect was seen in the arm, back, buttock, wrist, calf muscle and ankle regions, where workers with complaints of severe pain decreased to none of the workers complaining of "severe pain". There were 30.7 percent of workers who experienced an increase in the number of workers who did not feel pain in the elbow region, and there was a decrease in the number of workers who complained of "pain" in the elbow region (60 percent). Pain in the buttock with the "pain" category increased almost two-fold significantly. But no one had "severe pain" complaints in the buttock region after education. Pain in the calf muscle with the category "moderate pain" had the highest number and the highest number of "pain category" occurred in the thigh region.

WMSDs is a disorder that is often suffered by workers that dominate a musculoskeletal disorder which is indicated by complaints of pain in the muscles. This occurs due to soft injuries, especially to the muscles, which persist continuously and without treatment. The body's soft tissue has a tolerance limit in working, if it is overused, it will cause fatigue in the soft tissue and produce metabolic waste, it is lactic acid.

Workers cannot change their working hours because it is a production rule. Thus, long duration of work and long static positions are triggers for the emergence of WMSDs. Approaching management and production management is the right step to reduce WMSDs complaints among workers. Besides that, it was very necessary to increase knowledge about WMSDs to workers. This collaborative activity appears to have had a positive impact on WMSDs complaints at the herbal medicine production, at Luang Por Poen Hospital. Table 1 describes the significant impact of education about WMSDs on reducing pain complaints of workers. Education which was carried out by giving workers the task of doing stretching and exercising on the upper and lower limbs every day for 30 days was able to reduce the number of workers who complained of "severe pain" in several body regions. Exactly, in the arm, back, buttock, wrist, calf muscle and ankle. Musculoskeletal complaints are common among workers and can encompass a range of issues affecting the muscles, bones, joints, ligaments, and tendons. The main musculoskeletal complaints among workers often depend on the nature of their work and the tasks they perform regularly. Back pain is one of the most prevalent musculoskeletal complaints among workers, especially those who engage in heavy lifting, repetitive bending, or prolonged sitting or standing. This complaint usually happens because: (1) Incorrect posture or poorly designed workstations can put strain on the back muscles and spine, leading to pain and discomfort; (2) Jobs that involve repetitive movements, such as lifting, bending, or twisting, can cause strain on the back over time, leading to muscle fatigue and pain; (3) heavy lifting without proper training or equipment can result in back injuries and pain; (4) Jobs that involve sitting for long periods without adequate breaks or movement can weaken back muscles and contribute to stiffness and pain; (5) Stress can lead to muscle tension and exacerbate existing back pain, especially if individuals carry tension in their shoulders or back; (6) A sedentary lifestyle outside of work can weaken back muscles and contribute to back pain, making individuals more susceptible to

injuries at work; (7) Also age as the risk of developing back pain increases due to natural wear and tear on the spine and muscles (Yang et al., 2016).

This observation at Herbal Medicines production, Luang Por Poen Hospital found that workers with more severe pain in the neck and shoulder than in other regions. In addition, neck and shoulder pain is reported as the most common problem faced by workers as well, caused by spending time working in sitting while doing something. Workers who spend long hours at desks, using computers, or performing tasks that require repetitive shoulder movements may experience neck and shoulder pain. This pain is also provoked by some causes, such as sitting or standing with improper posture, such as slouching or hunching over, which can strain the muscles in the neck and shoulders over time, leading to pain and discomfort. Hence, the solution must do exercise or stretching of some muscles that support the neck and shoulder. Also, encouraging proper ergonomic setup of workstations, including adjustable chairs and computer monitors positioned at eye level, can help maintain good posture. Regular breaks to stretch and adjust posture can also be beneficial (Jung et al., 2020). Neck and shoulder pain also due to jobs with repetitive movement, such as typing on a keyboard or operating machinery, can cause muscle fatigue and strain in the neck and shoulders. Implementing ergonomic principles to reduce repetitive strain, such as providing ergonomic keyboards and tools, and rotating tasks to vary movement patterns are recommended to help alleviate strain on specific muscles (Soares et al., 2019).

Table 1 shows the high number of workers who complained of knee pain the same number with neck and shoulder parts. Knee pain usually happens in workers who do jobs that require standing for a long time, walking, kneeling, squatting, or heavy lifting may lead to knee pain and conditions like patellofemoral pain syndrome or meniscal injuries. Standing or walking on a hard surface can contribute to knee pain due to increased pressure on the joints. In these herbal medicines production, Luang Por Poen Hospital, most of the workers stood for some hours. Sitting position only in packing division. Furthermore, need a change of habit that decreases knee pain in workers. Provide anti-fatigue mats or cushioned flooring in areas where workers stand for long periods. Encourage the use of supportive footwear and allow for periodic breaks to rest and stretch the legs.

Exercise or stretching is very important to do by workers before work, during and after work. Also, it become a routine activity at home and the workplace. Apart from reducing the incidence of WMSDs, stretching also provides many benefits that regular stretching helping improve flexibility, joint mobility, and muscle elasticity, reducing the risk of developing work-related musculoskeletal disorders (WMSDs) such as tendonitis, carpal tunnel syndrome, and lower back pain. Furthermore, Regular stretching helps improve flexibility, joint mobility, and muscle elasticity, reducing the risk of developing WMSDs such as tendonitis, carpal tunnel syndrome, and lower back pain (Gasibat et al., 2023). Stretching that be done on targeting muscles is very good for maintaining proper posture, such as the back, shoulders, and neck, and can help alleviate muscle tension and promote better alignment, reducing the likelihood of developing posture-related issues (Oagaz et al., 2022). A previous report described that stretching increases blood flow to muscles and soft tissues, delivering oxygen and nutrients while removing metabolic waste products. Improved circulation can help reduce muscle fatigue, accelerate recovery from physical exertion, and enhance overall energy levels. As well, it promotes relaxation and can help alleviate stress and tension accumulated during the workday. Incorporating stretching breaks into the work routine provides employees with opportunities to unwind, release physical tension, and rejuvenate their minds (Hendrickse & Degens, 2020; Hotta & Muller-Delp, 2022). Wahab at all mentioned that stretching breaks provide opportunities for employees to momentarily disengage from repetitive or physically demanding tasks, helping prevent work-related fatigue and burnout. Incorporating stretching into the work routine can improve overall well-being and resilience to stress (Ab Wahab & Tatoglu, 2020). Thus, encouraging stretching as part of a workplace wellness program demonstrates an organization's

commitment to employee health and safety. Promoting stretching breaks fosters a positive workplace culture that prioritizes employee well-being and encourages healthy habits among workers (Reif et al., 2020).

The experts in health ergonomics determined clearly that stretching or moving can be done at pre-shift, regular breaks, and post-shift. In pre-shift, a brief stretching routine before starting work can prepare the body for physical demands and help prevent injuries. While, regular breaks mean incorporating short stretching breaks throughout the workday, such as every hour or two, allowing workers to periodically relieve muscle tension, improve circulation, and maintain flexibility. Then, post-shift performing stretching exercises at the end of the workday or after completing physically demanding tasks can help alleviate muscle tightness, promote relaxation, and facilitate recovery (Dubé et al., 2021). Ultimately, the key is to encourage workers to listen to their bodies, stretch gently and safely, and incorporate stretching into their daily routines to support their physical and mental well-being. Providing education, resources, and opportunities for group stretching sessions or ergonomic assessments can further support workers in adopting healthy habits and reducing the risk of work-related injuries. Incorporating stretching into the work routine, along with other ergonomic interventions and safety measures, can contribute to a healthier and safer work environment by reducing the incidence of work-related injuries and promoting overall well-being among employees (Mehrparvar et al., 2014).

4. CONCLUSION AND RECOMMENDATIONS

Overall, incorporating stretching into the work routine offers numerous benefits for workers, contributing to improved physical health, mental well-being, and productivity in the workplace. Encouraging employees to stretch regularly and providing opportunities for stretching breaks can contribute to a healthier and more ergonomic work environment. Stretching is highly recommended for workers, particularly those in occupations that involve repetitive movements, prolonged sitting or standing, or heavy lifting. In summary, regular stretching for workers offers many benefits, ranging from physical health improvements to enhanced mental well-being and productivity. Employers can support and promote stretching initiatives by providing education, resources, and opportunities for incorporating stretching into the workday.

This activity had some limitations, including: (1) convincing workers about the benefits of stretching for the body is not an easy thing, so it requires a lot of effort; (2) making company owners make stretching a habit for their workers also requires time and effort; (3) controlling employees to do stretching at home becomes a problem. which must be considered so that the muscles remain healthy when doing work. Hence, for the next projects: (1) intensive workshops and training can be conducted for workers so that workers get information stretching and its benefits. Use simple, relatable terms to explain how stretching helps reduce muscle tension, improve circulation, and prevent injuries; (2) make visual aids and handouts, such as posters and infographics. Place posters and infographics around the workplace highlighting the benefits of stretching, such as increased flexibility, reduced risk of injury, and improved posture; (3) the owner can give rewards for regular participation in stretch breaks or completing a set number of stretches each day. Visual aids can quickly convey important information; (4) digital tools and reminders are essential to remind the workers doing the stretching.

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