

Preventing Occupational Slips, Trips, and Falls on same level (STF) Exercise Intervention

Executive Summary

Occupational slips, trips and falls on same level (STF) is one of the most common incident types in occupational settings both locally and globally. When compared with different populations across the world, incidence rate (between 20 to 29 per 10,000 workers) and percentage (between 26.7 to 33.0% of all non-fatal incidents) of non-fatal STF in Hong Kong are higher than many regions such as Taiwan, Singapore, Canada, the U.S., Australia, etc. (between 5 to 20 per 10,000 workers; or 8.4-34.0% of all non-fatal incidents). Among the different industries, STF incidence rate is especially high in the manufacturing (between 36 to 46 per 10,000 workers), retail/accommodation/food services (between 32 to 40 per 10,000 workers), and construction (between 25 to 31 per 10,000 workers) industries. The risk of STF increases with age. With an aging working population in Hong Kong, the prevalence of occupational STF will most likely increase in the foreseeable future. Not only do older fallers take longer time to recover from their fall-related injuries, the average medical cost for them is also more expensive than treating a younger faller. In the US alone, the direct cost caused by falls on same level was estimated at USD\$10.62 billion in 2017, which was ranked second and accounted for 17.7% of all injury cost.

STF occur for a variety of reasons in the workplace. In general, risk factors can be categorized into (1) environment/extrinsic factors, (2) human/intrinsic factors, (3) work-related factors, and (4) management factors. Extrinsically, workers should pay closer attention to their work environment (e.g. surface and weather conditions), protective equipment, footwear, and factors that will affect their visual acuity or field (e.g. eyewear, lighting condition, visual obstacles, etc.). Intrinsically, though some factors are non-modifiable or not easily modifiable (e.g. age, gender, health condition), some of which can be improved by providing proper physical training (e.g. functional fitness, muscle mass, body mass index), education (e.g. safety awareness), medication and other substances, and work scheduling (e.g. fatigue management). Other work-related factors include work pace, urgency of task, task-related distractions, shift length, and load carrying. Finally,

management factors include work scheduling (e.g. project timelines, shift work, and urgency of task), company size, safety guidelines on hazard control, safety communication, etc.

Traditionally, much of the STF prevention efforts have been directed towards the environment/extrinsic factors, work-related factors, and/or management factors in occupational settings. However, with an aging working population, it is important for employers, as well as employees, to divert some of their STF preventive efforts into addressing the human/intrinsic factors. Based on our review, many different exercise interventions exist with varying degree of effectiveness in improving balance and reducing fall risk among older adults. Specifically, multi-component exercise intervention including balance, strength, and Tai Chi training has been shown to be the most effective in improving physical performances that correlate to various intrinsic fall risk factors. Furthermore, dual-task training (i.e. combining balance/gait training with motor/cognitive interference) is necessary as workers in various industries are often required to multi-task in their daily work routine.

Fall prevention exercise programme

The Department of Sports Science and Physical Education of the Chinese University of Hong Kong was entrusted by the Occupational Safety and Health Council to conduct this consultancy study. A fall prevention exercise intervention aimed to reduce STF risk was developed based on the literature and scientific theory, and its effectiveness was verified through a cohort study.

We proposed a 12-week exercise intervention programme in which participating workers were asked to exercise twice a day for five days every week. Each training session lasted around 10-15 minutes to minimize disruption to their usual work schedule, as they could perform these trainings before/ after work, or during their breaks.

There were three types of exercises: static balance training, dynamic balance training, and resistance training. To minimize fatigue, the morning session started off with dynamic warmup exercises followed by static balance training (i.e. standing in different stance while performing other upper body tasks), whereas the afternoon session alternated between dynamic balance training (i.e. walking/hopping/single leg deadlift) and resistance exercises (i.e. upper/lower body and core) aimed to improve muscle power. Tai Chi, a proven fall intervention exercise, was used as cooldown exercises after the afternoon session.

The difficulty of each training module would increase progressively every two weeks (e.g. with more challenging stance, motor/cognitive interference, disrupted sensory input, increasing intensity/magnitude, etc.) to minimize adaptation effect. Monthly workshops were held to instruct participants on how to do these exercises properly. Furthermore, exercise videos were posted online for workers to follow. To remind participants to perform these trainings, a mobile app was used to prompt them to do these exercises based on their preferred schedule. Participants were asked to record their completed training sessions using the mobile app for us to verify their compliance.

Pre- and post-training assessments were conducted to quantify each individual's physical performance and fall risk. Specifically, fall risk was estimated using a shortened version of the JISHA (Japan Industrial Safety and Health Association) questionnaire. Physical performance was evaluated using a few simple tests, i.e. (1) Static balance: Single-leg balance test with eyes closed, (2) Dynamic balance: Functional reach test and Y-balance test, (3) Agility: Four-square step test, and (4) Muscle strength: Five-times sit-to-stand test. Since our participants came from the working population instead of the frailer and older group, these tests were chosen over the common fall risk screening tools (e.g. Berg balance scale (BBS), Tinetti mobility score (TMS), and Mini-BESTest) to avoid ceiling effect.

A cluster-randomized controlled trial involving 105 participants with varying gender, age, height and weight was conducted to establish the effectiveness of the intervention. Due to the pandemic and personal reasons, 12 participants withdrew from our study, leaving 41 participants in the experimental group and 52 in the control group. Most of our participants came from two industries with the highest fall incidence rate in Hong Kong: construction and catering. As hypothesized, the experimental group who underwent 12 weeks of progressive, multi-modal balance training with online video demonstration and reminder had significantly improved balance control in multiple domains (i.e. static balance, dynamic balance, agility, and leg muscle strength and power) in comparison to the control group, regardless of their age and gender. Even physically active construction workers have showed significant improvement in their agility, as well as enhanced static and dynamic balance control. Our findings also showed that people working in the catering industry tended to have greater improvement than construction workers except for static balance, as both groups had improved similarly in that regard. This suggested our proposed intervention should provide even greater benefits for sedentary or less physically active individuals, such as those who mainly sit in front of a desk.

Recommendations

Improving working environment and management can reduce occupational STF; however, it is equally important to enhance employees' gait and balance control to address the intrinsic factors of STF. Our study has shown that our fall prevention exercises were effective in reducing fall risk by significantly improving our participants' static balance, dynamic balance, agility, and leg muscle power. Furthermore, our results revealed that our proposed intervention could potentially provide greater benefits for sedentary or less physically active individuals. We recommend OSHC and the industry to widely promote this exercise intervention to workers in Hong Kong. In addition, more safety trainings should be provided to raise their safety awareness. In combination with having safer work environment and management, a multi-pronged approach can effectively minimize STF accidents in occupational settings.

In order to lower the fall risk and fall incidence of workers in Hong Kong at the societal level, it is imperative to translate our knowledge to the general public, and to raise their awareness of the importance of personal fitness in fall prevention. OSHC should promote our effort through its website, workshops, and the media. To extend the reach to more workers, OSHC should also collaborate with the government, labour unions, contractors/manufacturers associations, and chambers of commerce to stress the importance of worker health and fall prevention in occupational settings. Ideally, like the construction workers, employees from high fall risk sectors should also be given designated time to perform exercises to prevent occupational accidents and injuries.