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Review of Warmup Programs in Industrial Work Settings

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Introduction

Working in the industrial setting is a highly active job [8]. The nature of manual labor can place added stress on the muscles, joints, tendons, and ligaments of the body, which then can increase the risk of developing musculoskeletal injuries (MSI) [2]. This added stress placed on the body can be from the high repetition, high load, high force, and awkward postures that are involved with this type of work [8]. Stretching has traditionally been used as an approach for injury prevention in various contexts including sports, other forms of exercising, and for work[8, 12].

There is huge debate in the literature on how warmup stretching affects prevention of MSI's, which makes it difficult to define the role stretching can have in injury prevention in the work setting [6, 8, 12]. Three different systematic reviews investigated the relationship between stretching and musculoskeletal pain and injury [6, 8, 12]. While some evidence showed that implementing warmup stretching programs can increase flexibility, all three systematic reviews found conflicting evidence that did not allow the researchers to exclusively conclude that stretching can prevent musculoskeletal pain or injury. This is likely because stretching as a warmup to the workday is not going to prevent MSI's if acting on its own [12, 21]. Preventing MSI's is very much a multifactorial approach, in which it is made up of a program involving ergonomic assessments, identifying risk factors, training, encouraging early reporting of MSI symptoms, and implementing solutions to control risks [12]. So, a warmup stretching program is just one element to a rather large and well-rounded MSI prevention program [6, 12, 21].

The Role of Stretching in Industrial Work Settings

Like many work settings, productivity is a priority for companies in industrial work [11]. For employees to work effectively and efficiently in this work setting, requires both physical and mental demands [11]. Therefore, workers need to prepare themselves both physically and mentally for the workday [11]. By tradition, stretching programs have been implemented to increase an individual's flexibility. Flexibility refers to the length of muscle tissue(s), whereby stretching increases the length of muscle tissue(s) and decreases muscle stiffness, allowing for the range of movement of a joint to increase [12]. When the muscle tissues are lengthened, the amount of force required to tear a muscle will be greater[12]. It is for this reason that some literature points to stretching as a strategy for injury prevention in the workplace. Increasing flexibility is not necessarily what industrial workers need in order to prepare themselves effectively for their day. One type of stretching, referred to as dynamic, has been supported in the literature to be of particular purpose for appropriately preparing the body for the active tasks it is about to do [19]. This is because dynamic stretching involves actively contracting and stretching the muscles over a number of repetitions, which increases the temperature of the muscles, and in so doing improves the extensibility of the muscles to perform work [19]. This way of actively and repetitively moving different parts of the body through full range of motion also increases an individual's heart rate and core body temperature [19]. This is important because of the active job types across the industrial setting, where there needs to be a preparation of the whole body for the movements, loads, and tasks that are involved in the workday. So, a dynamic warmup provides a rehearsal of movements and pre-activation of the muscles that are about to be used for the task [19].

As mentioned, preparing the body physically for the workday is only one piece of the puzzle. Workers in the industrial setting need to also prepare themselves mentally for the work tasks. A stretching program called IntelRapia, was implemented into Israel Intel Corporation manufacturing companies to increase mental alertness of the workers and reduce physical and mental fatigue[1]. However, after some years of its implementation, its use had been decreased, in order to create more time for workers to improve their productivity [1]. Abas and Kalir [1] report that in consequence of this action, there began to be more reports of mental and physical fatigue, as well as decrease in productivity. In response to this, Abas and Kalir [1] conducted a study looking at the effects of the IntelRapia on increasing alertness and reducing mental and physical fatigue. The participants were technicians from two manufacturing companies [1]. IntelRapia program took 15 minutes a day to complete[1]. The results showed workers had an increase in alertness levels (vigilance and mental workload capacity) when participating in the program compared to when not participating in the program [1]. Though the small sample size does not allow the findings to be generalized, the results of this study may indicate there is an important role for stretching programs in job safety and productivity output for the company, by enhancing a worker's alertness and reducing mental and physical fatigue.

Further, Rajendran[20] conducted a study gathering workers and employers' perceptions on warmup stretching programs. The participants reported there are benefits other than improving flexibility [20]. One being, there is a safety benefit to the morning stretching program, in helping to increase the employee's mental alertness levels before starting the days work [20]. This is consistent with the results of Abas and Kalir [1]. Also, employers reported that having a warmup program in the morning, allowed supervisors on site to oversee the employees, and use this opportunity as part of their safety planning to identify each workers job readiness [20]. Other benefits reported by employees included improved communication and worker morale among the team, as well as improved overall team building [20]. Stearns[21], a Technical Safety Specialist, wrote an article on workplace warmup stretching programs, where he discussed safety benefits to such programs. He explained that observing how the employees are participating in the morning stretch program, can help identify early signs of a potential musculoskeletal injury [21]. For example, if a worker is having difficulty or experiencing pain when lifting both arms above shoulder height, he may not be able to safely perform tasks that are required for the job. In addition, Safety Director, Graham, also wrote an article on the role of warmup stretching programs and offered his expertise [9]. He too, suggested that having all employees engage in an activity as a team can positively affect the team's level of bonding and morale [9].

Related to the mental readiness of employees, workers can also experience psychological stress from the high demands and pressures to be productive, and as a result, mental health difficulties can arise [5,11]. The psychological stress can affect a worker's ability to do their job effectively and impact their overall quality of life [5]. There are a variety of strategies to manage mental health difficulties, one being physical activity [5]. Yet, there has been limited research on how stretching programs can affect a worker's stress and quality of life because much of the research is focusing on MSI outcomes [11]. Holzgreve et al. [11] has conducted a study looking at how a stretching program can affect a worker's mental health and quality of life. The study used the 36-item Short Form (SF-36) Survey, which is a widely used and standardized health-related quality of life questionnaire that has been used on variety of different occupations [11]. The stretching program took place over 12 weeks, completed twice a week, for approximately 10

minutes [11]. The stretching program covered areas for all major body regions [11]. There were significant results in both the psychological and physical scores on the SF-36 pre and post and compared to control group [11]. Within the psychological component, significant improvements were in the mental health score, role limitations due to emotional problems score, and vitality score [11]. Within the physical area, significant improvements were seen in physical functioning and bodily pain scores [11]. Importantly though, the most significant results were found in the mental health component, which impacted the overall quality of life [11]. The limitation to this study is the program was for office workers and consisted of static stretching [11]. Future research needs to be done looking at how dynamic warmup stretches may affect workers stress and mental health in the industrial setting. The value this study may provide is that engaging in a movement-based warmup is not only important for physical preparation, but also mental preparation and management.

As mentioned, companies and employers care about productivity, and they constantly look at ways in which they can make their workers more productive. Based on the evidence presented thus far, the simple concept of moving your body may have huge benefits to an individuals physical and cognitive functioning, as well as their social dynamics and safety at work. And as a result, it can positively affect how productive workers are at their job. So, employers could consider implementing a warmup stretching program as a way to target all four components. Keep in mind, more research needs to be done to increase the validity of this statement.

Barriers to Implementing Warmup Stretching Programs in Industrial Work Settings

A limited amount of research has been done to date, identifying barriers, and exploring effective strategies for implementing a workplace warmup program. The overarching issue across the literature is that the design of such programs is not practical, and so companies, nor their employees will use it or adhere to it over time [15]. Chu et al. [5] declares there is a gap in research on strategies to enable better program adherence, and for this reason, there needs to be more research done so that companies and it's workers can gain the benefits a warmup stretching program can provide.

There is a multitude of factors that are contributing to impractical design and poor adherence of workplace warmup stretching programs. One, is companies and employees being hesitant to accept a program due to the added time and expense they perceive the program to be[12, 15, 16]. For example, implementing a dynamic stretching program will take time out of the workday, which can be viewed as lowering the company's productivity [16]. Christenssen[4] conducted a study dividing participants into two groups; one group participating in a daily warmup stretch routine and the second acting as a control. While majority of participants in the stretching program reported feeling benefits, all participants in the stretching group reported the design itself was not successful[4]. This was because the time commitment was too long and not realistic to implement into their workday [4]. These results show designing the program length to fit within a realistic time frame is important to generate successful participation. Along with that, it is also critical for the manager to buy-in to the program so that they are willing to put time and

investment into a warmup stretching program [12]. Safety director, Graham [9] proposes such a program needs to be viewed as having a benefit and return on investment to the company, otherwise the employer will not buy into the program. In addition, he discusses if the employer does not view the program as important, but implements it anyways, this attitude can feed into the attitudes of the employees that are participating in it, causing a low likelihood of the program being maintained[9]. Further, The Conference Board of Canada[23] gathered information on organizations from The Council Workplace Health and Wellness, summarizing strategies for implementing musculoskeletal prevention programs. The prevention programs included warmup stretching for the employees. Multiple organizations said buy-in to these programs is a challenge, with workplace safety culture being a reason to this [23]. For example, one of the organizations stated there is a "belief that doing a physical job means inevitable wear and tear" versus looking at a program with the belief that it "can enhance quality of life and longevity" [23, p.23]. In other words, some people within an organization can have the belief and attitude of 'I rather just get the work started then take time to warmup for 5 minutes, wear and tear is part of the job anyway'. Another barrier identified was from organizations who had employees spread across regions/provinces [23]. This made training and program implementation difficult to organize, and effort to sustain a program more difficult [23].

So, what is proving to be vital for buy-in, is the beliefs and attitudes of the company, employers, or employees. To make a shift in one's perspective and attitude, having the proper awareness and education is going to be instrumental for gaining buy-in. One strategy is having presentations to gain interest, awareness, and knowledge of the program [23]. For large companies who cannot gather all personal in one place, a presentation like this can be presented online [23]. Interestingly, Lowe[16] proposes that the presentations should be focusing on multiple ways it is beneficial to the company and their employers, rather than injury prevention [16]. This supports earlier statements where companies want to see how such a program can benefit the company, and not cause a significant disrupt on the companies' money and workers time. Along with providing education to employers, identifying how long the warmup program takes to complete can either support or deter a buy-in. The literature has shown that a time commitment of 5-10 minutes each morning can be a realistic time for employers to buy into as well as their employees to adhere to [2, 8, 9, 11].

Another barrier is the policies and procedures around health and safety practices of an organization [15, 16]. This would include having a policy that the training for a warmup stretching program is mandatory at orientation for all employees rather than not required [23]. Having training on how to perform each stretch is also critical to the success of the program, to avoid the stretches causing issues from incorrect performance [12, 16]. For companies that have workers dispersed across large areas, training online through video conference can be set up [23]. Along with policies for mandatory training, choosing to have the warmup program itself elective rather than mandatory can risk the program not being maintained overtime [9, 16, 23]. Aje et al. [2] conducted a program evaluation on a stretching program implemented at a food factory line/production which involved manual labor of lifting, carrying, pushing, and pulling, up to heavy loads for 8 hour shifts. Stretching program was 8 minutes, at the beginning of the work shift, paid for by the company [2]. The researchers suggested that by having the stretching time included in the employees pay, they likely felt responsible to complete it, impacting the 100% participation rate

[2]. This program evaluation can support a proposal that employees are able to maintain a stretching program when it is part of their shift and paid for [2].

Strategies

While some strategies have been discussed, the following research studies will provide more support for ways to design and implement a warmup stretching program that is successful and sustainable.

Hess and Hecker[12] completed a literature review of the American College of Sports Medicine recommendations for effective workplace stretching programs. One recommendation was that stretching programs should consist of stretches that target the areas of the body at risk for injury and relate to the job duties of the worker [12]. For industrial work settings, this means the program should realistically consist of multiple body regions (head to toe). Another recommendation is having adherence and consistency to a program so the participants can experience the intended benefits [12]. If workers experience positive benefits from a warmup stretching program, they will be more likely to adhere to it overtime [12]. To have good adherence and consistency, these measures should be monitored so adjustments can be made if needed [12]. Identifying the best measures for adherence will be discussed in the next section of the literature review. Furthermore, another strategy offered in Hess and Hecker's [12] review is having a leader, whether that be the employer or an employee, lead the stretches, to provide more structure to the program. Similarly, an environmental, health and safety officer, Paul Haining, involved in implementing a stretch and flex program across his cooperation, suggested having the employees at the work sites rotate who leads the daily warmup, to help the workers on the team feel "sense of ownership in the program" as cited in 17 para.[13]. In a scenario where work sites have employees starting out in different locations across a city, my proposal would be to have the leader still run the warmup routine, through an app on the phone (ex. facetime, zoom, google meet). Alternately, there could be a buddy system of 2-3 employees that contact via phone each morning and engage in conversation as they each complete the stretches. This way, even sites where individuals start alone, can still feeling part of a team, enhancing the team morale and communication. While theoretically this could be a useable strategy, the limitation is there has been no research done on investigating the effectiveness of this strategy for workers who start independently and not with a group.

Gartley & Prosser [8] conducted a study consisting of two manual labor jobs that required repetitive lifting, carrying, pushing, and pulling heavy loads. After the proper training, the employees were either given a poster page of the exercises to refer to, or a photo was hung up in a common area where stretching took place each morning [8]. Supervisors led the stretching program and they tracked the participation to measure compliance [8]. Incentives were offered every 30 days for continued participation [8]. Over the 3 month period, there was 100% participation, and on follow-up, the companies reported continuing even after completion of the study and implementing the program to their other work sites also [8]. Given the successful participation results, this program was effective in its design for offering helpful strategies for adherence to a warmup stretching program [8].

Chu et al. [5] conducted a literature review on the effectiveness of physical activity programs in the workplace on mental health. Based on the results, they proposed some strategies to promote better adherence. First, to identify the psychological barriers of employees to participating in activity programs and providing strategies to address them. A limitation to this strategy is this process can take up quite a bit of time. Another strategy is creating goals to achieve a specific amount of activity each week [5]. Alike the other research evidence discussed, having regular follow-ups to review progress, and having incentives for accomplishing the goal of the program were included as effective strategies [5].

Dadaczynski et al. [7] conducted a study looking at the effectiveness of promoting physical activity through an online tracking intervention using game design elements. They created an online tracking intervention called Healingo Fit, which focused on low intensity exercise (walking) [7]. Design was based off socio-cognitive learning theory, theory of planned behavior, health action process approach, and gamification approach [7]. Based off the gamification approach, they used the following with the intention of increasing participation- points system, badges for achieving awards, ranking leader boards, and cities as a level structure [7]. They also included daily and weekly goals, daily multiple choice quizzes, and challenges (both team and individual based) [7]. Results showed there was an increase in health and physical activity related knowledge, increase in intention (to be physically active in future) from pre to post, and increase in self-efficacy (referring the intention to exercise even when faced with obstacles) [7]. Results indicated a 30% increase in walking activities. The challenges and awards were used as motivational cues, which could be a particular strategy for participants who are not motivated to participate. Also, researchers propose that having participants be able to see their own progress visually likely influenced their self-efficacy, and motivation [7].

Li et al. [14] states that remaining adherent to exercise programs at work is often challenging, and the main barrier employees experience is viewing a work exercise program as an 'inconvenience' of their time. Li et al. [14] conducted a study looking at the acceptance of exergames for work wellness programs, and factors that affect workers acceptance of exergames. Exergames is a term to describe exercise games and can be a method to increase motivation to participate [14]. This study based their measurements off theory of reasoned action and technology acceptance model [14]. Using these models, they used four measurements using a 5-point Likert scale: perceived usefulness, perceived ease of use, attitude toward use, and intention to use. The results of the study indicated that a worker's acceptance of exergames was more significantly influenced by how easy they felt using the app was, and not how useful they viewed the game was [14].

Judit, et al. [13] completed a systematic review looking at the effectiveness of using smartphones to measure and influence physical activity. Results of the literature review found the following as important elements for better engagement of physical activity: having profiles of participants physical activity, having feedback of ones own progress, setting goals, social networking to connect and share progress, and access to consultations with experts [13]. These results are consistent with the recommendations presented above from other research studies.

Steinmetz et al. [22] completed a metanalysis on effectiveness of behavior change interventions that are based off theory of planned behavior (TPB). Behavior change interventions

can be another effective strategy in improving adherence to warmup programs. This theory has been used for interventions for behavior change [22]. TPB "states that the "main driver for behavior is the intention to perform the behavior" [22, p.216]. And intention is influenced by three motivational factors: attitude toward a behavior, the subjective norm of the behavior, and perceived behavioral control [22]. These three motivational factors will be generated by a person's beliefs [22]. The results of the metanalysis showed that increasing skills was most successful for changing attitude towards a behavior [22]. Most successful method for changing perceived behavior control was persuasion (providing person with positive statements they will be successful with the behavior and argue against self doubts) [22]. Motivation as a method was most successful for changing participants intention[22]. Further, behavior change interventions had the strongest effects related to physical activity and were most successful when delivered to a group rather than individuals, in public settings rather than private [22]. Therefore, using this framework could be an effective strategy for implementing successful workplace warmups. Steinmetz et al. [22] also discussed the importance of differentiating between motivational processes and implementational processes when choosing the appropriate methods for an intervention. Motivational processes are the "processes that result in … creating an intention" and implementational processes are the "processes that help in implementing the behaviors" [22]. For the purpose a warmup program, we want workers to develop an intention to participate, then implement that behavior into the program to have long-term participation. According to the steps outlined by Steinmetz et al. [22] for each process, I have come up with elements specific to implementing a dynamic warmup program: (1) Create an intention to perform the behavior, by targeting the three motivational factors- attitude toward the behavior, subjective norm, and perceived behavioral control. Using increasing skills to target attitude, persuasion to target perceived behavioral control, and motivational methods to target intention and behavior. Examples of motivational methods presented in Steinmetz et al. [22] metanalysis included the following- self motivating statements, evaluations of own behavior (how do I feel), incentives/rewards, and goal setting. (2) Identify the beliefs/barriers to participating and maintaining participation long term, from the evidence presented in this literature review. (3) Utilize the identified strategies in the literature review to combat these barriers when implementing the program. (4) Lastly, create measurements/indicators based on the goals of the program (and including measures to evaluate the three types of beliefs), to use as evaluating the programs effectiveness of a warmup program [22].

Indicators for Success

To create program goals that are meaningful, and work to create longevity and sustainability of a warmup stretching program, the use of leading indicators becomes an important part of the approach. The Conference Board of Canada[23] completed a collection of data on its members regarding implementation of MSI prevention programs. Three out of the eighteen organizations used leading indicators as a strategy for successful maintenance of their MSI prevention programs [23]. For example, one organization reported using participation rates of a daily warmup as their leading indicator [23]. The rest of the companies used lagging indicators [23]. Some of the lagging indicators used were injury rates, cost savings, time loss, and number of incidences [23].

Leading indicators are a new approach to evaluating health and safety in the workplace and take on a proactive method to the workplaces health and safety compared to the reactive approach of lagging indicators [3]. Leading indicators are used as a measurement tool to achieve the health and safety goals of a program by identifying areas that need improvement [3]. Lagging indicators, however, simply measure the result of health and safety goals, so it fails to indicate what areas need improvement in order to achieve the goals that are set [3]. By using leading indicators to create program goals, it changes the workplace culture to have a positive lens by focusing on "presence of safety" rather than negative program outcomes such as "absence of injury" [3 p.8]. Also, leading indicators are measuring the contributions that employers or employees are making to the OHS policies [3]. As a result, the employees participating in a warmup program can feel accountable and experience positive reinforcement when they see they are contributing to achieving a goal [3]. This can produce an increase in motivation to stay committed on a personal level and as a team, which in turn can enhance the workers moral [3]. The challenge with leading indicators is the unfamiliarity of it because it is a new concept to Occupational Health and Safety (OHS), and there is limited evidence on navigating and choosing appropriate leading indicators [3].

Measurements to track and evaluate the program

Hawley-Hague et al. [10] completed a literature review on defining and measuring adherence of older adults participating in exercise classes. Based on the results, Hawley-Hague et al. [10] outlined the importance of using both completion and attendance, rather than just one or the other, when measuring adherence. By including both, you are acknowledging the participants attitude, commitment, and satisfaction with the program "in terms of physical and social outcomes" [10 p.4]. Using only attendance may falsely indicate low commitment, when really a worker's attendance is being affected by other situations such as a health condition, or away on vacation [10]. In the case of a vacation, a worker may have missed two weeks for holidays, but he still considered to have good commitment because when he is at work, he is completing all exercises. Using only completion can make a worker appear as though have high commitment because they have completed every warmup they attend, when in fact they have consistently missed numerous workdays. So, you need both (completion and attendance) to get a complete understanding of the adherence to a program. Lastly, Hawley-Hague et al. [10] found there is inconsistent definitions of adherence across the literature[10]. Therefore, they recommend measuring attendance as "percentage of classes attended out of the actual number of sessions offered"; and completion as "those who are still attending the class" [p.4], or when they are at work, are they completing the warmup or sitting out [10].

McCallum et al. [18] did a scoping review looking at effectiveness of apps and wearables for evaluating physical activity. With apps improving the efficiency of data collection, this method is gaining a lot of interest [18]. They looked at engagement and acceptability as measurements to indicate effectiveness[18]. Engagement was defined "as users' interaction and usage behavior"; and acceptability was defined as "users' subjective perceptions and experiences" [18 p.2]. Based on the results, three levels of engagement are revealed: frequency of using the app, depth of engagement (ex. number of challenges in the app one did, adjustment of goals), and length of use [18]. For acceptability, they found studies mostly used questionnaires either by using already established questionnaires or developing their own [18]. Examples of

questions included: satisfaction of using the app daily, level of intention to continue to use it, social encouragement when using the app, whether app is perceived as enjoyable/fun, how user 'feels' about the app [18].

In the systematic review previously discussed by Judit, et al. [13], they looked at measurements most commonly used in assessing the effectiveness of using smart phone for influencing physical activity participation. They found the two most commonly used were compliance and perspectives of the participants [13]. Also, results showed increased compliance with using smartphones/apps to measure activity and progress, compared to paper-based [13].

Conclusion

To implement a dynamic warmup program that is going to be effective and maintained, is it essential to use evidence-based practice to support the decisions and plans for implementation. Using the research evidence outlined in this literature review can provide awareness of the barriers that exist and possible strategies to use in successfully implementing a dynamic warmup program. In addition to using best evidence, there should also be a theoretical framework to guide your thoughts for planning the implementation process. The TPB can be a exceptionally valuable framework to use in designing a warmup program to improve motivation to participate, adherence rates, and overall program longevity. Lastly, having the appropriate measurements that reflect the goal of the program is critical for evaluating the program. Having the right measurements can identify areas that need improvement, so the program can be adjusted for greater success.

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