Exploring The Myth Behind Stretching Programs

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Over the past few decades, many employers have “pinned” the blame of workplace injuries on the employee, indicating that a fit and able-bodied employee should be able to perform the job as designed without injury. Often, in lieu of appropriate tools, equipment, layout, or process flow, or where engineering improvements are not feasible, the employer looks for an easy alternative. He turns to the nurse, therapist, safety manager, industrial hygienist, or insurance carrier to develop a “stretching program” to eliminate work-related musculoskeletal disorders (WRMSDs).

While stretching is a valuable tool if used as part of a therapy program designed for an individual with a diagnosed musculoskeletal problem, its value as a “prevention” tool for WRMSDs is highly questionable. To understand this, the reader should closely consider the mechanism and physiology of stretching.

What is the mechanism behind stretching?

In simple terms, muscles are made of groups of fibers that contract (shorten) and relax on command through a complex communication system between the brain and the specific muscle. The voluntary muscles that comprise the musculoskeletal system are strongest and cycle normal blood flow best when starting from a neutral resting muscle length. Muscles can shorten or lengthen over time in response to chronic awkward working postures, years of bad habits, poor postural awareness, or deformities in the musculoskeletal system (e.g., leg length differences or scoliosis). One muscle group shortens while the opposing muscle group lengthens in response to the orientation of the skeletal system. Both groups become weaker. Weaker muscle fatigues sooner and the compromised blood flow bring less oxygen back to the working muscle fibers for energy and repair at a micro level.

Beyond the physiology of muscle activation, shortened and lengthened muscles may alter the mechanics of the skeletal system by changing the angle at which bone move around each other. For example, tight chest muscles (particularly pectorals) that may result from a chronically “slumped” forward posture, rounded shoulders or working in a forward reaching posture. This may lead to compression of the brachial plexis that is the major bundle of nerve, blood and lymph supply to the arms. Compression here can cause sensory changes and weakness in the hands and arms. While the chest muscles shortened and weaken, the mid-back muscles are elongated, weak, and often painful.

Stretching is more popularly thought of as a mechanism to lengthen muscle, however it is also indicated for resolving other types of soft tissue problems. Damage to the tendon, ligament, or capsule of a joint can limit its ability to move to end range. Without a valid differential diagnosis, the exact cause may not be apparent. While stretching a shortened muscle to attain normal resting length is beneficial, stretching beyond this range may in fact lead to hyper mobility and instability. The key is to know when and what to stretch, if at all.

What is missing from typical stretching programs?

Beyond stretching muscles for increased flexibility, there are three very important components not addressed by these programs. First is the need to strengthening the "opposite" muscle group which was identified in an earlier example of the lengthened and weak mid-back muscles. Second is the integration of meaningful and functional motor control at this newly acquired end range of the stretched muscle. Using the theory of motor control (Shumway, et. al), the development of meaningful movement results from the integration of three basic components: the individual, the task, and the environment. Stretching affects muscle length (the individual), yet it fails to integrate voluntary motor action in this lengthened range. Take the example of pushing down on a lever from an overhead position (the task). The execution of this task and motor control required is influenced by the handle height and shape as well as force to move it (the environment). In other words, stretching is only one element of a three-stage process of motor movement. Alone does not necessarily lead to better muscle function. A third component that may or may not be addressed is postural awareness while working, playing, and relaxing. When a person can recognize, choose, and assume good postures, the body is more likely to operate from a neutral starting point and the risk of MSDs may be reduced.

Why are corporate stretching programs so popular?

With a better understanding of the mechanism and purpose of stretching, take another look at why corporate stretching programs are so popular. Stretching programs supposed to improve flexibility, and flexibility is supposed to improve general fitness. General fitness is supposed to improve the cardiovascular system which pumps blood to working muscle, improve endurance for a full day's work, and reduce the risk of WRMSDs. From the employee's perspective, stretching programs reflect a management structure that is supportive of employee well being. From the management's perspective, it appears to be easy to implement and less expensive than changing or redesigning equipment, work processes, or workflow. It also puts the burden of injury prevention on the employees and program leaders. Taking a closer look at actual cost, management may have bought a bill of goods that is significantly more expensive than imagined and much less effective for controlling WRMSDs than expected.

How much does a stretching program really cost?

First, examine purchase price. An off-the-shelf written program or video may cost $100 or more. While the price is low, it does not necessarily provide a system for ensuring that the stretches are performed correctly. And there is no guarantee that the stretches are appropriate for the job tasks or physical environment of the facility. For example, it may not be prudent to sit on the floor of a chemical plant or a controlled clean room, or to prop a foot on a piece of machinery (even if not running at the time) to stretch the hamstrings. A custom or customized program based on a first-hand evaluation of job tasks and the work environment, work and break schedules, and space available for the program might cost between $2500 - $5000. This figure may or may not include initial training and periodic refresher training, video instruction, or posters. Beyond the cost of development is the training cost that includes salary time to teach group leaders and employees. Training, at least at the group leader level, may require several sessions to ensure competency. Next consider the cost of non-productive or "down" time and the impact that can have on meeting scheduled deadlines.

The following is an example program cost for a company of 100 employees excluding the investment for program development and initial leader training. In this example, the program requires 5 minutes total and may be performed once or twice each shift.

- 5 minute program = (3 min stretch + 2 min prep/finish)
- 5 minutes represents approximately 1% of base payroll
- 5 minutes/480 minutes in workday = 1.04% of workday for one session
- 10 minutes/480 minutes in workday = 2.08% of workday for two sessions
- If employee makes $10/hour and is paid for 2,080 hours plus 30% for benefits, then the cost for this one employee for one daily session is:

  Cost = [($10/hour x 2,080 hours) +
  (0.3)($10/hour x 2,080 hours)] x 1.04%
  = $281.22 each year per employee
- Add on 30 minutes of orientation at 0.5 hour x $10 = $5.00 per employee
- If you have 100 employees, then your annual cost is:

  100 employees x ($281.22 + $5.00) = $28,621.60
  for a single session each or
  100 employees x ($281.22 + $281.22 + $5.00)
  = $56,743.60 for two sessions/day

To determine return on investment (ROI):
ROI = ($\sum$ reduced workers' comp cost x probability of success) ÷ (direct cost)
=($100,000 x 10%) ÷ $28,621 x 10% = 35%

For every dollar spend, your ROI is $.35.

If you provide the program twice/shift, your probability of success might increase to 15% but your cost doubles. Then, for every dollar you spend, your ROI is ~$.26. Is this the best way to spend limited funds?

Beyond the actual daily cost, how effective is stretching for reducing WRMSDs?

To answer this question, take a closer look at flexibility that is the tool by which effective stretching is measured. Most stretching programs use three tests to evaluate flexibility: the sit and stretch test, shoulder rotation, and trunk rotation.[34,35] According to the literature, it is unclear if "sit and stretch" range improvement is due to flexibility in the back or hamstrings. This improvement is probably due to increased hamstring length, yet there is no direct correlation between hamstring length and low back flexibility.[32] There is also little evidence that lumbar and/or hamstring flexibility is associated with low back pain.[26,35] In fact, flexibility and stretching may be unrelated to injury risk.[37,38] According to research by Corbin, et. al., "There is insufficient data to support the common prescription of stretching programs to modify flexibility based on the hypothesis of reducing the risk of muscle injury."[11] And there is little evidence that greater than normal flexibility reduces injury risk.[10] Based on a variety of research projects, Corbin postulates that both high and low levels of flexibility may increase the risk of injury.[11] Therefore the importance of proper screening prior to participating in stretching program should not be underestimated and is rarely required prior to participation.

How long is "long enough" when you're stretching?

Assuming that appropriate screening has been completed and a company is ready to start its stretching program, how long should the participant hold the stretch to receive benefit from this activity? A review of the literature gives durations that vary considerably.

- 3 repetitions with a 30 second hold for each [2,45]
- 3-4 reps / 3-60 second hold[4,41]
- 4 reps / 15-30 second hold[46]
- Unspecified reps / 10 second hold[8]
- Unspecified reps / 10 or 30 second hold ➠ (2 min. total)[9]
- Unspecified reps / 15-20 second hold[3,5,7,31]

But the most reliable data demonstrates that a hold of 30 seconds for young people and 60 seconds for elderly is most effective.[49]

When is the best time to stretch?

The next issue to consider is the best time of the shift to provide the stretching program. While some articles suggest that stretching should occur as part of the general warm-up, 15-20 minutes before and after exercise[3,19], others suggest it should be done after a warming thermal modality (e.g., ultrasound) or warm-up when tissue temperature increases.[41] Research by Cornelius et. al. suggests that *when* a person stretches is not a significant

factor for increased joint range of motion.[14] The best conclusion that can be drawn from available research is that the jury is still out on this issue and more research is required for conclusive evidence. And regardless of when stretching occurs, research shows that although the benefits may last up to 24 hours, gains are most effective immediately after the stretch and then decline after 15 minutes.[15,21] Therefore long-term programs are needed for long-term gains.[33]

What about warm-up? Do they fit into the picture?

Aside from stretching, a common theme that appears in a majority of the literature is the benefit of warm-up prior to any physical activity. Warm-up can be generalized such as riding a stationary bicycle or slow jogging to stimulate blood flow throughout the body, or it can be muscle specific such as swinging a baseball bat through full range at a slow and easy pace prior to actually batting in a game. In either case, the increased circulation facilitates rapid and complete dissociation of oxygen from the hemoglobin in the blood to the muscles that need it most during physical activity.[40] Also preconditioning muscles with warm-up exercise can increase muscle temperature for up to 30 minutes, opening intramuscular blood vessels. This reduces strain at the muscle tendon junction and reduces risk of injury here.[39] Muscles appear to have greater extensibility and flexibility.[3,28] Where joint range is limited by shortened muscles, warm-up coupled with exercise of the "opposite" muscles will better prepare an individual for physical activity, be it work or weekend sports.

What does the research say about stretching?

For every professional journal or research article by those who institute successful stretching programs and who use stretching as a therapeutic tool, there is stronger evidence that stretching may not be as effective as formerly stated. Researchers such as DeVires et. al. postulate that stretching may reduce delayed onset muscle soreness (DOMS) after strenuous or prolonged exercise. DOMS is thought to be the stage preceding tissue damage.[16] However, other researchers demonstrate that there is no statistically significant reduction in DOMS after stretching.[24.27,38] There is no evidence of injury rate reduction. [34,36,42] Also, while there is an increased tolerance to stretch, the analgesia may increase the risk of damage at the cytoskeletal level because the individual may not get sufficient sensory feedback to know when to stop.[42]

Researchers such as Holt et. al. found that stretching increases flexibility and may reduce imbalances that lead to injury. However, the more flexible side has a higher risk for injury.[35,44] Other researchers have found that in the presence of normal muscle length, stretching is not a significant factor in sports such as with jogging.[42] Since it is believed that most injuries occur during eccentric (or lengthening) contractions within *normal* range, stretching to achieve length *beyond normal range* would not be effective for reducing

injuries.[42] Additionally, improperly performed stretching and overstretching may cause micro tears in the muscle fibers.[3,42]

Researchers such as Shellock, et. al. found that stretching might increase muscle temperature and better prepare them for strenuous physical activity, preventing injuries.[40] However other researchers found that while stretching may improve the viscosity or ability to elongate muscle, it does not improve the elasticity or stiffness that is highly correlated with micro tears.[30] Herbert, et. al. postulates that if an average of 100 people stretch for 12 weeks to prevent one injury, the average subject would need to stretch for 23 years to prevent one injury.[24] Even if you improve flexibility and stretch or strengthen a muscle, unless there is adequate neuromotor learning at this range with voluntary activation of key muscles, the added muscle fiber, strength, and range is nothing more than decoration. The true benefits of a stretching program may come from the increase in an employee's perception of his/her own body attractiveness and overall self-worth.[33] It may also increase postural awareness and encourage employees to ask for help when needed and identify unsafe behaviors or situations.

With all this controversy surrounding the cost and effectiveness of stretching programs, what should a company do to reduce WRMSDs?

Start by working with management to identify and reduce ergonomics risk factors. Instituting engineering solutions where technologically and financially feasible will target the source of the problem and provide long-term solutions that do not rely on employee compliance. Supplement with administrative solutions such as job enlargement and/or job rotation that limit exposure to high-risk activities. For companies that want to promote positive attitude, loyalty, and wellness, incorporate start-of-shift "warm-up activities and exercises" as part of an overall safety and leadership program. These programs both mentally and physically prepare the employee for the work shift. They get the heart pumping blood throughout the whole body, then activate muscles at end range to integrate motor function. As part of the leadership program, the supervisor assumes greater responsibility for overall employee safety and participation in the process. Choose activities that "stretch" over-worked muscles while dynamically exercising the "opposite" muscles that are likely to be elongated and weak. For example, the popular "executive move" exercise passively elongates the upper chest muscles while activating the muscles that pull the shoulder blades together. Even more important than performing these activities at start of shift, encourage employees to incorporate the exercises as micro-breaks performed spontaneously throughout the shift so it becomes a habit and part of how they do business. After a few months, employees may get bored, so change them periodically. One option is to incorporate props such as exercise rods, bands, or balls to renew interest. Most importantly, reinforce management commitment to employee well being by having supervisors and high-level managers participate periodically. Then recognize participants with program-

specific rewards that can be low-cost, but relate to either the work performed or the safety and leadership program goals.

Conclusion

While stretching alone does not appear to be the most effective mechanism for managing WRMSDs, it does take a step in the right direction to increase awareness concerning the benefits of movement, circulation, and posture. Even the most advanced use of equipment and design possible in new facilities requires human interface and vigilance. Adding a warm-up and exercise as part of an overall safety and leadership program can stimulate blood flow and movement when the job calls for static postures, it can activate overstretched and tired muscles to reduce fatigue and improve postural awareness, and it can go a long way to support company loyalty. And loyalty can be priceless!

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Additional Article

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