

Construction Workers' Perception of Stretch and Flex Program Effectiveness in Preventing Work-related Musculoskeletal Disorders

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Abstract: This study aimed to identify the perceptions of construction workers on the effectiveness of stretching programs in preventing work-related musculoskeletal disorders (WMSDs). A quantitative research approach was adopted for the study. This involved the development and distribution of a short questionnaire as the survey mechanism. The participants were 315 construction workers from five construction projects and five specialty construction firms from the western United States. The majority of the workers (~98%) perceived that the Stretch and Flex (SF) program helped prevent work-related musculoskeletal disorders. Nearly ninety-five percent of the participants performed SF daily. Participants reported several other perceived benefits of the SF program. There is a common perception among the construction workers who participated in the study that stretching & flex exercises will prevent WMSDs. Empirical research is recommended to examine, why do workers have this perception that SF program helps prevent work-related musculoskeletal disorders and injuries in the construction industry.

Keywords: Stretch and Flex program, WMSD, Injury prevention, Worker perception, Construction

1. Introduction

Work-related musculoskeletal disorders (WMSDs) are a group of painful disorders of muscles, tendons, and nerves (CCOHS, 2011). WMSDs do not happen as a result of a single accident or injury. Rather, musculoskeletal disorders may occur when muscles or tendons are stretched or over-used beyond their capabilities (Choi & Woletz, 2010). The construction industry has suffered the most from these injuries (BLS, 2011). The physically demanding nature of construction work helps explain why strains and sprains are the most common type of injury resulting in days away from work in construction. Nearly 35% of all non-fatal injuries and illnesses in the construction industry resulting in days away from work were due to sprains and strains (The Center for Construction Research and Training, 2011). Construction continues to contribute to a significant portion of WMSDs in other countries as well (HSE, 2011). Ergonomic solutions may help to reduce overexertion and, therefore, the risk of WMSDs. Ergonomic solutions aim to reduce or eliminate ergonomic risk factors with the help of engineering or administrative controls (Choi & Woletz, 2010). Engineering controls typically involve redesigning a workstation or a process to reduce the ergonomic risk factors. Administrative controls include rotating workers through a particular workstation to effectively reduce the exposure to an ergonomic risk factor (Choi & Woletz, 2010). Workplace stretching program can be an example of administrative control. Stretching programs are intended to reduce the incidence and/or severity of injuries by increasing flexibility. Flexibility is commonly defined as the range of movement possible around a specific joint or series of joints, and this definition is applied in most clinical studies. It is a common belief that workers who are less flexible are more likely to have musculoskeletal pain and resultant injury. The presumption is that, for individuals with short or "tight" muscles, stretching exercises increases flexibility by elongating tissues to a more physiologically normal range, promoting optimal function and reducing the risk of musculoskeletal injury (Hess & Hecker, 2003). Stretching programs are commonly referred to "*Stretch and Flex (SF)*" in the construction industry. There is a growing interest in, and use of, SF programs to reduce the risk of WMSDs by construction contractors and workers

(Boatman, et al., 2012). Even though, the construction industry has been slow to adopt comprehensive ergonomic solutions (The Center for Construction Research and Training, 2011), several construction companies in the United States have instituted a SF program as part of their work place safety and health program (Rajendran & Gambatese, 2009). This trend can be attributed to several leading occupational safety trade journals and articles reporting that SF programs will prevent WMSDs. One report indicates that experience among companies that institute stretching programs suggests the frequency and severity of average sprain and strain claims, as well as lost workdays, fell by more than 50 percent (Roehrig, 2012). While these reports are frequently published in trade journals, they are typically based on uncontrolled and quasi-experimental in-house evaluations that rely on self-reported outcomes rather than objective measures (Hess & Hecker, 2003). There is a need to verify if there is a common perception among construction workers that SF programs are effective in preventing WMSDs. If workers perceive that SF program helps in the reduction of WMSDs, workers may have a false sense of safety that SF program may alone help them prevent work-related musculoskeletal disorders and injuries.

1.1 Study Objective

The purpose of this study was to identify the perceptions of construction workers on the effectiveness of stretch and flex programs in preventing work-related musculoskeletal disorders. The results could enable ergonomic, safety and health professionals as well as construction project management to provide construction workers with better education about the effectiveness of SF program in musculoskeletal injury prevention.

2. Method

2.1 Participants

The study was focused on construction workers from five large construction projects (budget more than \$50 million) and five large specialty construction firms. Two projects were industrial, and three were commercial projects. The project sizes ranged from \$90 million to \$300 million. All the projects were being built in the western United States. The five responding specialty firms' annual volume of work ranged from \$20 million to \$100 million. All the responding firms typically performed work in the western United States. The specialty firms and projects with a SF program were the selection criteria. In an attempt to obtain inputs from major construction trades, eight specialty firms representing different trades were included: excavation/demolition, concrete, reinforcing steel (rebar), electrical, mechanical (dry side), mechanical (wet side), drywall, and roofing. The projects were selected to ensure other construction trades such as architectural firms are working at the time of the study. The firms and the projects were selected based on convenience and their willingness to participate in the research.

2.2 Research Design and Survey Instrument

A quantitative research approach was adopted for the study. This involved the development and distribution of a short questionnaire as the survey mechanism. The perception survey was developed by the authors and was not piloted, which is a major limitation to the study. The perception survey is one of the effective ways to collect data for this type of research (O' Toole, 2002). The survey questionnaire composed of two sections. The first section solicited demographic information about the workers such as: the worker's trade, their standing (journeyman or apprentice), their role (worker or supervisor), and years of experience in the industry. The second section consisted of questions requesting their perception of stretch and flex program on injury reduction and the SF program specifics. The participant perceptions were obtained with the help of yes/no questions and open-ended questions. The survey questions used to collect data for this study is presented below.

2.2.1. SF Program Perception Survey Instrument

- Trade: _____
- Status: Apprentice Journeyman
- Role: Craft Supervisor
- How long have you worked in this trade?
- Have you been trained in stretch and flex (SF)? Yes No
- Do you perform SF daily at work? Yes No

- If you answered yes to question above, answer the questions below.
- How many times you perform SF per day? How long per session?
- When do you normally perform SF?
- Do you think the above time is sufficient to get a good SF? Yes No
- Do you believe SF prevents soft tissue injuries (WMSDs)? Yes No
- If no, do you believe it reduces the severity of soft tissue injuries (WMSDs)? Yes No
- What other ways does SF program helps you?
- Any suggestions to make the SF program better?
- What is the reason that you do not perform SF?
- What are the improvements we can make for you to start doing the SF?

2.3 Data Collection

The authors sent the paper questionnaires to safety professionals (contact person) working at the selected projects and specialty firms. The survey questionnaires were administrated to the workers on job sites through the site or company safety professionals. The questionnaires were handed out to the participants during their break time with verbal instructions, allowing them to read and respond to the questions. Workers were informed that participation in the survey was voluntary, and all responses to the questions will be kept anonymous (no self-identifying information on the survey). They were asked to respond to the questions based on their experience with the SF program in the construction industry. The safety professionals who administrated the survey did not keep track of how many questionnaires were circulated among the workers. Hence, a valid response rate was not calculated for the study - another limitation of the study that could have led to sampling bias. Once completed, questionnaires were collected by the safety professionals and forwarded to the author for input and analysis. Completed questionnaires were received from all five projects, but only five out of eight specialty firms responded to the questionnaire. The study met all criteria of an Institutional Review Board through the Human Subjects Review committee affiliated with the author's institution.

2.4 Data Analysis

The data collected in the study were analyzed using both quantitative and qualitative methods. Quantitative analysis was completed using Statistical Program for the Social Sciences (SPSS) 19.0. The Pearson's chi-square test and Fischer exact test was used to analyze the categorical perception data (yes or no response). Open-ended questions were analyzed qualitatively by examining common themes to assess the participants' perspectives regarding the benefits of SF program. Qualitative research techniques are particularly useful for gathering information in this type of research (Max & Lynn, 2003).

3. Results

3.1 Participant Demographics

A total of 315 completed questionnaires were returned from five construction projects and five specialty firms (i.e., a total of 13 different trades: concrete carpenters, crane operator, drywall carpenter, drywall finisher, electrician, pipe fitter, insulator, reinforcing ironworker, laborer, operator, plumber, sheet metal worker, and architectural). The contact person (safety professionals) from each company and projects did not keep track of how many questionnaires were distributed. Hence, a response rate is not included. However, the number of responses (n=315) received was reasonable considering the difficulty of access to the data being collected. Analyses of the data revealed that most of the participants were represented by mechanical trades such as the pipe fitters (19.4%), sheet metal workers (16.8%) and plumbers (7.3%). In the United States, construction trades such as laborer (59.0), plumber (44.5), carpenter (43.5), Sheet metal workers (42.3), electrician (40.7), drywall (38.9) and concrete (35.3) – are in the top 10 in terms of overexertion injury rates (rate per 10,000 full-time workers) with days away from work. Similar trends were found for back injuries and illnesses with days away from work (HSE, 2011). It was interesting to note that the study participants include all the trades with the highest injury rates. Therefore, the results of the study provide the perspectives of construction trades who are considered high-risk in terms of exposure to WMSD hazards.

3.2 Participant SF Program Specifics

This section reports the current SF trends among the participants. The participants were asked six questions to understand their SF expertise (training) and daily workplace SF routine. Based on survey findings, the results are summarized in Table 1.

Table 1. Frequency Distribution and Percentage of SF Program Metrics†

SF Program Measure	N	%
Trained in SF		
Yes	295	94.2
No	18	5.8
Performs SF daily at work		
Yes	295	94.6
No	17	5.5
Number of times SF performed/day (session)		
Once per day	234	81.6
Twice per day	38	13.2
Three times per day	11	3.8
Four times or more per day	5	1.7
SF duration per session		
Less than 5 minutes	11	3.9
Between 5 to 10 minutes	194	69.5
More than 10 minutes	74	26.5
Total SF duration per day‡		
Less than 10 minutes	59	21.1
Between 10 to 15 minutes	187	67.0
More than 15 minutes	33	11.8
Time of day SF is performed		
Morning	240	84.8
Before each shift	12	4.2
During breaks	30	10.6
Before each task	1	0.4
Sufficiency of above duration for an effective stretch and flex		
Yes	282	94.3
No	17	5.7

†The responses in various categories do not add up to 315. Some survey participants did not answer all questions.

‡Total duration = Participant frequency x time per session

Ninety-four percent of the workers were trained on SF exercises. Of the thirteen trades in the study, all sheet metal workers and electrical workers were trained in SF exercises. 73.5% of workers who has never received SF training performed SF exercises regularly. One question asked whether the participants performed SF daily. The majority of the participants (94.6%) responded positively. Drywall carpenters were among the least compliant, with only 78.5% performing stretching exercises. Of the workers who did not perform SF exercises 70.5% of them were trained in SF. Workers were asked the reason for their non-compliance with the program. One worker stated that “no one does it properly,” while another worker mentioned “it was not being done as a group”. The study participants were asked how many times they performed SF per day. Out of the 307 participants who responded to this question, 234 (81.6%) performed SF once per day; 38 (13.2%) performed it twice per day; 11 (3.8%) three times per day, and five (1.7%) performed the exercise more than three times. The majority (84.8%) of the participants performed the exercises in the morning before the commencement of work, followed by thirty (10.6%) participants who performed SF during break time. The next question asked the participants regarding the duration of SF per session. The response varied from 1 min to 20 min per session (mean=9.1 mins). Of the 279 workers who responded to this question, 69.5% of the participants’ exercise time ranged between 5 to 10 minutes. The amount of time spent on SFs per day was computed by multiplying the frequency by the time per session. Similar to session duration, the amount of time spent of SF per day ranged from 2 min to 60 min (mean = 10.5 minutes). Majority of the workers (89.5%)

reported it was sufficient time to perform the SF exercises, and 5.4% felt the time they spent on SF exercises is not sufficient to benefit from the SF exercises.

3.3 SF Program and WMSDs prevention - Worker Perception

In this section, the worker perception, the difference in perception based on participant demographics, and SF specifics was examined. Table 2 provides a summary of the perception response based on participant demographics and selected SF program specifics. The results of the survey participants' perception were answered using the following research questions.

- *What is the perception of the construction workers in the study, on whether SF program helps prevent WMSDs?*
 Of the 301 workers who responded to this question, a majority of the workers (97.7%) perceived (answered "yes") SF program helped prevent WMSDs. A chi-square goodness-of-fit test indicated a statistically significant difference between the responses, $\chi^2(1) = 273.65, p = 0$. Furthermore, 90% of workers perceived SF programs will help reduce the severity of WMSDs.
- *Are there differences between the perceptions of the different construction trades on whether SF program helps prevent WMSDs?* The majority of the workers in every trade category perceived SF program helps prevent WMSDs. A Pearson chi-square test was performed to examine the statistical differences between the trades. However, due to the large number of zeros in the "no" response a valid statistical test was not performed.
- *Are there differences between the perceptions of supervisors and workers, on whether SF program helps prevent WMSDs?* All the supervisors (100%) and 97% of the workers perceived SF program helped prevent WMSDs. It was found that the participant role does not affect the outcome of their perception (2x2 table Fischer exact test; 2-sided $p=0.352$). Fischer exact test was used since the response counts (no responses) were not large enough in some cells.
- *Are there differences between the perceptions of apprentice and journeyman, on whether SF program helps prevent WMSDs?* A significant portion of apprentice (97%) and journeyman (97.7%) perceived SF program helped prevent WMSDs. The results showed that the participant training level does not affect the outcome of the participant response (2x2 table Fischer exact test; 2-sided $p=0.563$).
- *Are there differences between the perceptions of participants based on whether they were trained in SF?*
 Only 2.5% of participants who were trained in SF program perceived SF did not prevent WMSDs. On the other hand, of the 17 untrained participants, perceived SF helped prevent WMSDs. Furthermore, the data showed that the SF training did not affect the outcome of the participant response (2x2 table Fischer exact test; 2-sided $p=1.0$).
- *Are there differences between the perceptions of participants who performed SF and did not perform SF?*
 Most of the participants who performed SF daily (96.2%) perceived SF is beneficial in reducing WMSDs. Statistical analysis indicated that participant "SF performance" did not affect the outcome of the participant perception (Fischer exact test; 2-sided $p=0.25$). The results indicate that the survey participants irrespective of their SF program routine and demographics, perceived SF program helped prevent WMSDs.

Table 2. Participant Perception vs. Participant Demographics and SF Program Metrics†

Demographics	Perception‡	
	Yes	No
Trade/Profession		
Architectural Trade	34	1
Concrete Carpenter	32	0
Crane Operator	1	0
Drywall Carpenter	40	2
Drywall Finisher	7	0
Electrician	20	0
Pipe fitter	58	2
Insulator	1	0
Reinforcing ironworker	10	0
Laborer	19	0
Operator	1	0
Plumber	20	2
Sheet metal worker	51	0
Job Classification		

Supervisor	61	0
Worker	222	7
Training Level		
Apprentice	32	1
Journeyman	260	6
Number of years in trade		
Less than 5 years	64	0
Between 5 and 10 years	43	1
More than 10 years	169	5
Trained in SF		
Yes	277	7
No	7	0
Performs SF daily at work		
Yes	283	6
No	11	1
Number of times SF performed per day		
Once per day	228	6
Twice per day	37	0
Three times per day	11	0
Four times or more per day	5	0

†The responses in various categories do not add up to 315. Some survey participants did not answer all questions

‡Does SF program help prevent WMSDs?

3.4 Perceived benefits of SF program

The survey also solicited input on their perception of other benefits of SF program. This was an open-ended question in the survey. The participants (n=90) identified several SF program benefits. Some of the participant responses were grouped into similar categories:

- Mental preparation – helped wake them up in the morning, keeps participants alert, focused, and gets them ready before the commencement of work (37.7%),
- Physical preparations – increased their flexibility and felt limber and loose, and allows find areas of pain (27.7%),
- Helped with communication and team building since SF are performed as a group (13.3%),
- Safety Planning – helps with safety pre-task planning and safety discussions before the commencement of work (11.1%),
- General physical health (6.6%), and
- Prevent muscle injuries (1.1%).

3.5 Perceived benefits of SF program

Another open-ended question asked the participants for suggestions to improve the SF program. Twenty eight workers responded to this question as follows:

- Increase the time to perform SF exercises (10.7%),
- More training and education (target muscle groups) (10.7%),
- No change required (10.7%),
- More back stretch (10.7%),
- Workers should take SF seriously (10.7%),
- Increase the frequency – sessions per day (10.7%),
- Change SF exercises from time to time (7.1%),
- Workers should perform SF properly (7.1%),
- SF should be made mandatory (7.1%), and
- Other comments made once included: add breathing exercises, SF tailored to the limitations of on their body, make afternoon SF mandatory, include dynamic stretching, and require warm up exercise prior to commencement of SF.

4. Discussion

This study examined 315 construction workers to understand their perception regarding the effectiveness of Stretching & Flex (SF) program in preventing work-related musculoskeletal disorders and their current SF practices. Despite the study limitations, the findings depart and contribute to the body of knowledge. The survey participants irrespective of their SF program habits and demographics perceived SF program helped prevent WMSDs. Statistical analysis indicated that neither participant demographics, nor their stretching practices affected their perception. In addition, workers perceived there were other SF program benefits such as increased alertness and focus, communication, team building, improved flexibility, and safety planning. Construction workers in this study demonstrated a high level of compliance with SF program, with ~95% performing SF daily. Majority of the workers were trained in SF, however; there were a small number of workers who performed SF without any training. The study participants spent a combined 3,296 minutes (54.93 hours) a day on stretching exercises. According to the “Workplace Statistics by Industries” (BLS, 2012), a U.S. construction worker makes on an average \$ 33.08 hourly wage, which equates approximately half a million dollar expended a year by the study participants on stretching. It is surprising to observe this trend, despite the fact there is little scientific evidence on the benefits of stretching in preventing WMSDs (Costa & Vieira, 2008). In fact, SF was not even part of the list of ergonomic administrative controls recommended in a recent study (Ugbebor & Adaramola, 2012). It is suggested that construction contractors and firms should spend money on a proven ergonomic intervention control (Hess & Hecker, 2003; Costa & Vieira, 2008), as WMSDs itself is costing them millions through worker compensation claims (National Occupational Research Agenda for Musculoskeletal Disorders, 2001). Empirical research is warranted to investigate why do workers have this perception that SF program helps prevent WMSDs. Further research is also recommended on why construction companies/projects started implementing SF programs despite lack of evidence to prove its effectiveness. These future studies might provide some useful insights on SF program’s benefits to the construction industry.

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