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Review Article

Posture Wellness Solutions in the Workplace: A Current Review

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ABSTRACT

Increasing prevalence of mobile technology and declining mobility often lead to poor posture and increased healthcare costs, all of which require better ergonomic interventions. Musculoskeletal disorders are often caused by progressive compromised posture and diminished physical recovery. They are commonly seen in the workplace which not only negatively impact productivity and increase absentees but incur significant health costs. The purpose of this review is to evaluate the existing research regarding the effectiveness of ergonomic interventions designed to improve musculoskeletal wellness in the workplace, and present newly wellness technology for potential ergonomic improvement. Twenty-one studies sourced from Google Scholar and PubMed were reviewed. The programs evaluated in these studies include sit-stand desks; intermittent standing bouts; ergonomic interventions or education; exercise programs; and posture wear. The results were mostly positive in preventing and alleviating musculoskeletal symptoms but failed to decrease health care costs. More research and innovations should be focus on more cost-effective interventions to improve posture in the workplace, especially on workplace posture correcting cost effective solutions.

Keywords: Posture; Ergonomics; Workplace wellness; Musculoskeletal disorders; Musculoskeletal symptoms; Low back pain; Posture-perfecting apparel; Posture correction; Ergonomic solutions; Workplace ergonomics

INTRODUCTION

Posture is defined as a line of gravity and how it relates to limbs and other areas of the body. It involves energy use, mechanical movement of joints and muscles, balance, flexibility, emotional states, and many other physical, physiological, and psychological functions [1]. Black et al, found that a variety of sitting postures affected the cervical area of the spine [2]. This suggests the importance of proper alignment of the head, neck, thorax, lumbar, and the pelvis to improve posture.

MSDs and posture in the workplace

Musculoskeletal Disorders (MSDs) are injuries and disorders of the musculoskeletal system, such as carpal tunnel syndrome, neck, and back pain. They are often caused by poor posture and over-use syndromes. Work-related MSDs are very common, especially as office work require excessive computers and mobile phones usage. MSDs are the largest category of workplace injuries in the US and spending annually has been over $90 Billion to the healthcare system and employers.

Work environments place a great deal of physical stress on workers. There is strong evidence for an association between work and musculoskeletal diseases [3]. One study examined the prevalence of low back pain and neck symptoms in dentists while sitting at work Ratzon et al, correlating to dental occupation risks [4]. There was a large correlation between sitting time and the intensity of the LBP and neck pain.

With the increasing use of fast computing technology in the workplace, it has become very common for compromised posture and progressive musculo-skeletal complaints. The shift from manual labor to computer labor is associated with increased sedentary behavior which impacts health care costs. This shift leads to a decrease in physical activity and an increase in disease prevalence [5]. Prolonged cell phone usage is associated with a larger head flexion angle. In one study, subjects sustained a head flexion angle of 30 degrees from the vertical, normal position while using a smartphone [6]. Berolo et al, examined participants who self-reported symptoms of pain [7]. The results suggest that there is a relationship between the use of cell phones and musculoskeletal pain in the shoulders, neck, and extremities. Cell phone usage and other forms of technology has also been shown to be associated with a higher prevalence of musculoskeletal disorders [8]. There are a variety of physical concerns associated with cell phone and technology usage, most commonly seen is musculoskeletal issues. This poor aligned habitual posture from cell phone usage leads to altered body biomechanics seen in the neck, low back, and hands, as well as inflamed muscle tension (Tegmeier, 2018).

In the past 10 years we have witnessed a growth of Video Display Terminal (VDT) workstation, a type of computer displays with a screen. VDT workstation have shown to place tremendous stress

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on the body due to a slouching postural position. Many of these workstations require prolonged sitting and limit movement of the arms, legs, back, and neck. This pose has caused fatigue and increased the risk for chronic musculo-skeletal complaints [9]. VDT workstations also are correlated with higher levels of neck and shoulder discomfort, suggesting the need for ergonomic interventions and risks improvement [10].

Productivity loss due to MSDs

Several studies have demonstrated that musculoskeletal conditions have a negative impact on workers' productivity. Lotters et al. found that 60% of workers had a reduction in productivity following return to work after a 2- 6-week sick leave because of a musculoskeletal condition [11]. This loss in productivity was associated with poor physical health, greater disability, and diminished relations with the supervisor. This demonstrates the importance of timing and working conditions for employees' return from absences due to musculoskeletal injuries.

One study examined data from the 2008 US National Health and Wellness Survey to study productivity loss in workers with musculoskeletal pain [12]. They found that workers with arthritis, back, and fibromyalgia pain reported rates of absenteeism that were 1.5 to 3.2 times higher than those without these conditions. They also looked at presenteeism and found that workers with musculoskeletal pain reported that 28% to 45% of their time at work was ineffective due to their pain. Another study had workers with Upper Extremity Disorders (UEDs) self-assess their productivity loss at work due to their UEDs. Of the participants, 56% reported that they experienced productivity loss, and of those participants, the reported average reduction in productivity was 34%. They found that the main factors that caused productivity loss were the interference of pain on work and sleep [13]. As musculoskeletal problems cause significant reductions in productivity at work, employers are concerned with workplace interventions that will help manage posture and back pain.

Return-to-work interventions for workers with MSDs

Several reviews have been performed assessing intervention programs that assist with returning employees to work following absence due to musculoskeletal problems. There is overwhelming evidence that workplace-based interventions are the most effective in reducing the duration of sick leave and the cost to employers.

Several studies found that interventions in which multiple domains worked together were also more effective. For example, health practitioners working with both employers and employees to implement work modifications were found to be the most effective in one review of return-to-work intervention studies [14]. Another review categorized intervention strategies into three different domains: health-focused, service coordination, and work modification interventions [15]. They found that multi-domain interventions were the most successful in reducing the amount of time employees were on sick leave due to musculoskeletal or pain-related conditions and mental health problems.

One longitudinal study examined a cohort of 632 claimants with work-related musculoskeletal injuries [16]. They found that those employees who accepted work accommodation offers and advice from a Health Care Provider (HCP) on re-injury prevention had significantly shorter sick leave. The three main components in reducing the duration of workplace absence were work accommodations, HCP advice to the workplace, and ergonomic visits to the office.

Purpose

The purpose of this review is to summarize prior research in relation to ergonomic interventions and prevention programs for musculoskeletal disorders and pain experienced during work in office settings. In addition, this paper will address current advanced research and provide potential technology directions for cost effective solutions to improve office ergonomics.

MATERIALS AND METHODS

All research articles were found using Google Scholar and PubMed. Key search words included "posture," "effects," "correction," "musculoskeletal injuries," "productivity," "body," "postural interventions," "ergonomics," "posture correction," "workplace," "loss of productivity," "sick days," "effects," "body," "musculoskeletal symptoms," "cell phones," "sit stand desks," "cell phones," and "technology." Studies were included in the review if they discussed ergonomic intervention programs to manage musculoskeletal problems in the workplace and measurable outcomes in improving musculoskeletal wellness in the workplace. Studies were excluded if they did not meet these criteria.

RESULTS

The studies reviewed here fell into three categories of workplace interventions: sit-stand desks and intermittent standing; ergonomic interventions, education or training; and posture correcting methods. We evaluated the effectiveness of each of these types of interventions in improving posture wellness in the workplace.

I. Sit-stand desks and intermittent standing (n=8)

The implementation of sit-stand desks is one potential intervention for improving workplace ergonomics. In a study by Straker et al. call center workers were evaluated by an ergonomist who noted the type of desk they used, classifying them as either "sit" or "sit-stand" desks [17]. Researchers used inclinometers to monitor time spent sitting and interviewed participants assess ergonomic awareness. The proportion of time spent sitting was significantly lower in workers at sit-stand desks than workers at sit desks, but there was no significant correlation between desk type and ergonomic awareness. In another study, university employees with low back pain were randomized to receive sit-stand workstations [18]. Participants using sit-stand desks reported a significant reduction chronic lower back pain. Husemann et al. had participants complete a data entry task and randomly assigned an intervention group to use a sit-stand workstation and the control group to sit for the duration of the task [19]. They found that participants who followed the sit-stand paradigm had significantly fewer musculoskeletal complaints. Ebara et al. studied a group of university undergraduates and aged workers and assigned them to three different conditions: sitting at regular workstations, sitting at a high chair with an elevated work surface (high-chair), and alternating between sitting and standing with the same work surface and chair setting and the high-chair condition (sit-stand) [20]. The participants reported their musculoskeletal discomfort levels. Contradictory to the previous studies discussed in this section, the results indicated that the sit-stand and high-chair conditions resulted in higher discomfort levels than the standard desk condition. These results may have differed because this sit-

stand intervention included a high chair with a desk elevated to a standing height, and the others involved a standard height desk setting. Overall, sit-stand desks are effective in reducing sitting time and reducing lower back pain. These studies suggest that sit-stand desks may be an effective ergonomic intervention for improving posture in the workplace.

Intermittent standing is another type of intervention that helps to reduce sitting time and back pain. Thorp et al. ran a study with overweight and obese office workers and assigned them to two different groups: a sit condition, where participants had a standard office setting and sat at a desk, and a stand-sit condition, where participants changed between sitting and standing every 30 minutes [21]. Using self-report measures, the researchers found that intermittent standing in a workday could reduce musculoskeletal symptoms, while maintaining productivity. Danquah et al. evaluated the effectiveness of the "Take a Stand!" program, which includes a variety of components including a sit-stand desk, intermittent standing and walking, and setting collective office goals [22]. The results indicated that there was a reduction in musculoskeletal pain after three months in the neck and shoulder areas, but not in the back and extremities. The "Take a Stand!" program was also effective in reducing total sitting time in the office. Overall, intermittent standing bouts may be effective in reducing sitting time but display mixed results in terms of musculoskeletal symptoms. It may be effective in reducing minor symptoms, yet the results are mixed.

II. Ergonomic interventions/training/education programs (n=15)

Several studies evaluated the effectiveness of various ergonomic interventions and training programs in improving posture and managing musculoskeletal problems in the workplace. From this review, we found that ergonomic interventions and education are both effective in improving posture and reducing musculoskeletal discomfort. However, the most effective program is the coupling of these two treatments.

Many studies examined ergonomic interventions in workplaces and compared an intervention group with a control group. In general, these studies found that the workers who underwent an ergonomic intervention had a significantly lower level of musculoskeletal problems after the intervention. In a study by Levanon et al. computer workers underwent an ergonomic intervention that included work site and body posture adjustments as well as muscle activity training and exercises [23]. As compared with the control group, the workers in the intervention group had a significant reduction in musculoskeletal disorders as well as improved posture. In a study on sickness absenteeism caused by musculoskeletal disorders, workers with MSDs were assigned to either a workplace ergonomic intervention in addition to a more proactive role for insurance case managers, or traditional case management. They found that in a 12-month period, the intervention group had significantly fewer sick days than the reference group [24]. In one study on VDT workers by Pillastrini et al. a physical therapist evaluated each participant's posture and provided changes to their workstation by correcting any of the following: chair and desk height, backrest incline, computer screen height and orientation, mouse location, keyboard location, or giving them a new chair [25]. The researchers used the Rapid Entire Body Assessment (REBA) to evaluate work-related posture as well as LBP point-prevalence for LBP pain measurement. The REBA and LBP scores both decreased following intervention, suggesting that this intervention and evaluation by a physical therapist may decrease low back pain as well as improve work-related posture. Gerr et al. studied computer users and assigned them to either a control group or one of two different intervention groups: a conventional intervention, based on recommendations from different sources, and an alternate intervention, based on protective factors for musculoskeletal disorders [26]. The interventions included changing the position of the keyboard relative to the body, adjusting the armrests, changing the chair, or other instructions. Participants ranked their discomfort level on a scale from 1-10 and self-reported their symptoms. There was no significant difference in musculoskeletal symptoms between the two intervention groups and the control group. The results suggest that these two intervention groups were ineffective at improving musculoskeletal symptoms. Spekle et al. used a questionnaire method to evaluate changes from baseline relative to a follow-up in terms of an ergonomic intervention program that included a workstation check, visit to physician, and an education program on the reduction of symptoms of arms, legs, and shoulders. Data was collected through RSI QuickScan questionnaires, monitoring risk factors to musculoskeletal symptoms [27]. The results found no significant effects in terms of risk factors for musculoskeletal symptoms. This may be because the tested population consisted of a variety of computer workers who both had symptoms or did not have symptoms. Aaras et al. evaluated the effectiveness of an ergonomic intervention to support the forearms and hands on the desk. This corresponded with a decrease in shoulder pain and a decrease in the load on the trapezius load [28].

We also reviewed studies that looked at the effect of ergonomic training programs on workers' musculoskeletal discomfort and found that these are effective methods of improving this aspect of workplace wellness. Robertson & O'Neill set up an ergonomic training program then used an electronic survey and ergonomic knowledge test to examine office ergonomics and work-related musculoskeletal pain. The survey revealed that the training was beneficial to understanding office ergonomics [29]. There was also a decrease in discomfort in lower back, elbows, fingers, and legs for the training group. In another study, participants performed a lab-based customer service representative job for 15 days and were assigned to either an ergonomic training group or minimal training group [30]. The self-reported musculoskeletal symptoms for the trained group were significantly lower than those for the minimally trained group. Additionally, a study on the workers at Isfahan Province Gas Company tested the effect of ergonomic training on musculoskeletal symptoms. They found that workers who received the training had a significant decrease in musculoskeletal symptoms [31].

Finally, several studies looked at both ergonomic interventions and ergonomic education and compared the effectiveness of these two options as well as the pairing of ergonomic intervention and training in a combined program. In a study with VDU workers, participants were assigned to either an intensive ergonomic intervention or ergonomic education [32]. The intensive intervention group were provided with an ergonomic checklist emphasizing conditions of the workroom, workstation, and breaks. The ergonomic education group consisted of a one-hour training session concerning ergonomic awareness. This group received the same checklist as the intensive ergonomic group, as well as tips on work postures. The researchers used questionnaires, ergonomic ratings of workstations, workload measurements, as well as diaries to monitor discomfort.

Both groups showed less musculoskeletal discomfort than the control group after the interventions. Another study found that office workers who received both a workplace intervention and an office ergonomics training program experienced a significant decrease in musculoskeletal discomfort [33]. For the intervention, workers were given a highly adjustable chair. This study also had a group who received the training only, and these workers reported a slight decrease in discomfort. However, combining ergonomic workstations with ergonomic training is the most effective. Rempel et al. evaluated the effectiveness of four different interventions: ergonomic training, trackball and ergonomics training, forearm support and training, and forearm support board, trackball, and training [34]. Participants in the intervention groups experienced a lower level of pain relative to the control, specifically in the upper body area. In terms of productivity, the researchers found no significant effect.

III. Posture correction solutions (n=6)

Posture correction at workplace has also been an ongoing physical wellness improvement at the workplace. One study evaluated the effectiveness of an exercise program focused on posture correction for university students [35]. The exercise program consisted of 20-minute sessions of stretching, straightening body shape, and other posture correcting exercises, three times a week, for a total of eight weeks. Using a 10-point scale, the participants reported that the exercise program was effective in reducing neck, shoulder, back, and pelvis pain. In another study, Andersen et al. evaluated the association between physical heavy lifting and Long-term Sickness Absence (LTSA) [36]. The results found that if a worker was exposed to a heavy workload for over 25% of work time, they had a higher risk for LTSA. This suggests that heavy workloads and physical labor have a large impact on absence from work.

Most of the current research is on ergonomic interventions in the workplace, which mainly affect the external environment of the worker. Little research has been done on interventions concerning medical clothing by using posture technology gear worn by the worker. Recent studies have shown an equally effective solution using posture correcting gear. IFGfit designs posture perfecting clothing that has shown consistent data for a potential workplace gear. Liu et al. examined the effect of wearing an IFGfit posture-correcting shirt on scapular alignment [37]. They measured the distance between the shoulder blades of the 21 participants before and while wearing the posture correcting apparel and found that the shoulder blades were closer together and closer to the spinous processes with the smart posture gear. As improved scapular symmetry and alignment corresponds with improved posture, this study demonstrated the biomechanical advantage of wearing IFGfit posture activewear. Chawla et al. reviewed posture and workplace wellness and found IFGfit posture-correcting apparel to be an effective solution for workplace to decrease neck and back pain [38].

Another study focused on the effectiveness of IFGfit posture apparel in terms of increasing comfort level and reducing back and neck complaints and whether there is potential for high compliance with using the apparel as a treatment to alleviate and prevent back pain [39]. Out of the sample of 128 participants, 93% reported a high comfort rating of good or excellent, 88% felt an improvement in posture, and 96% indicated that the apparel could help them in their daily activities. This data further suggests that IFGfit posture perfecting apparel is comfortable, and is an effective, alternative in terms of a preventative measure and therapeutic implementation.

Toh et al. examined the effect of the IFGfit posture perfecting activewear on NCAA Division-One athletes, a population that is prone to physical and mental stress, and poor recovery due to progressive musculoskeletal injuries [40]. In this study, 47 student athletes tried on the IFGfit posture correcting activewear. 100% of the study participants were satisfied with the comfort of the shirt, and 95% experienced an improvement in posture after wearing the garment. Additionally, 89% of participants reported that they would consider using the gear as part of physical therapy or recovery from an injury. These studies demonstrated that IFGfit posture perfecting apparel can be comfortable and highly compliant. In addition, it can be considered as an effective preventive or therapeutic posture correcting clothing in the workplace [41].

CONCLUSION

Many studies have evaluated the effectiveness of ergonomic interventions aiming to reduce workers' musculoskeletal symptoms and improve productivity. Twenty-five studies were included in this review. These studies evaluated the effectiveness of sit-stand desks, intermittent standing, ergonomic interventions, and posture correcting methods. Wellness technology and posture improvement methods may become more cost-effective solutions in the near future. Healthcare costs should be assessed in wellness technology and posture correcting solutions in future endeavors.

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