The Effects of Back Belts on Reducing Low Back Pain in an Occupational Setting: A Literature Review

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Abstract

***Objective*:** Low back pain affects between 60% to 80% of adults at some time during their lifetime. One of the main causes of the low back pain comes from employment, with the bulk of it coming from people in material handling. This review evaluates the effectiveness of low back belts in preventing low back pain in an occupational setting.

***Data Sources*:** The data was accumulated by searching the PUBMED database for all relevant articles published in English between 1993 and 2003. Bibliographies of pertinent articles were searched for more relevant articles.

Study Selection and Data Extraction: A total of 27 articles were identified as being relevant to the subject, with 21 of the articles reviewed for this article. The data was based on its relevance to the topic. There is an incorporation of a standard text, along with refereed journals.

Conclusion: There is no solid evidence to recommend the use of low back braces to reduce pain in an occupational setting.

Key Words: Low Back Pain, Back Braces, Back Belts, Workplace, Lumbar Belt, and Injuries.

Introduction

Low back pain affects more than 60% of the United States adult population at some time in their lives, with low back injuries being one of the nation's most common occupational disorders (1). Occupational lower-back problems are the leading cause of worker disability in industry (2). Each year low back injuries cost the nation an estimated $20 billion to $50 billion annually according to the National Institute for Occupational Safety and Health (NIOSH) (3).

A work-related musculoskeletal disorder (MSD), defined by the U.S. Department of Labor as "an injury or disorder of the muscles, nerves, tendons, joints, cartilage, and spinal discs" that is not caused by slipping/tripping or trauma incidents, negatively impacts the private industry sector (4). In 2000, MSDs accounted for over 34% of total injuries and illnesses resulting in missed work (4). Along with the $20 billion in direct costs, it is estimated that another $100 billion in indirect costs including lost wages, decreased productivity, litigation fees, hiring of replacement employees and overtime pay (4).

As a result of the increasing frequency of workplace injuries and the related costs, lumbar back belts have gained popularity in many industries under the assumption that their use will reduce low back injuries and decrease medical costs as a result. Since the peak incidence of injury is between the ages of 25 and 60, which are the most productive years of working; it has a particular impact on industry as a whole (5).

As shown from some of the statements above, the incidence of occupational low back pain is definitely on the rise. A quote from Wassell states: "Human beings have had backaches throughout recorded history, but we now face an epidemic of chronic disability resulting from simple strains and sprains (6)." The literature seems to support the quote above and it is demonstrating an alarming increase in low back pain (LBP) (1). The most common way employers attempt to prevent injury to the low back is the use of a back brace or belt. One major aspect that was inconsistent in the studies was the type of back brace that was used. Some of the back braces had suspenders, while others had an inflatable cell (7). Either way, it seems that the result of the studies have not been swayed based on which type of belt was used (7). In this paper, the author would like to show the lack of effectiveness of back braces in preventing injury, showing other risk factors that can be a cause of low back pain in employees, and a guideline for prescribing back braces.

Discussion

There are a few different ideas on how back braces are perceived to help prevent low back pain. One idea is that a back brace will help slow the muscle fatigue of the spinal musculature (8). Another idea is that the use of back belts increases the intra-abdominal pressure and thus increasing the stability of the spine (7). It is also thought that back belts are designed to change the lifting style of the individual preventing certain ranges of motion and/or decreasing the load on the spine (9).

Belt's Role in Reducing Fatigue

The issue of reducing muscle fatigue is not supported in the literature. Back belts have long thought to reduce the load on the extensor muscles of the back to reduce fatigue. In the study by Cirello and Snook, thirteen male industrial workers performed lifting and lower tasks 2 days a week for 4 weeks (8). The subjects lifted for 1, 2, 3, and 4 hours in consecutive days for the first 4 days of the experiment, which were considered training days. During the final 4 days of the experiment the subjects lifted for 4 hours each day. For two days the subject lifted with a back belt and 2 days without a back belt. Maximum isokinetic endurance of the extensors was measured for 50 repetitions at the end of 4 hours lifting. The extensor muscles were measured with an electoromyographic signal from six locations for 30 seconds at 80% of maximum isometric voluntary contraction after 4 hours of lifting (8).

As expected, the results showed a significant decrease (about 10%) in maximum isokinetic endurance after 4 hours of lifting (8). However, there was no significant difference between maximum isokinetic endurance when wearing the back belt and isokinetic endurance when not wearing the back belt (8). The data also shows that there was no difference between those who wore the belt first and those who wore the belt last.

According to the results, none of the dependent variables showed an improvement as a result of wearing a back belt. This was seen in the fact that the isokinetic endurance did not decrease significantly enough after the use of the back brace to warrant the use of a back belt (8). This is significant because training of back extensors has been a successful treatment for restoration of the spine and decreasing pain (8). The hypothesis of this experiment was not supported by the data of the experiment. There was no significant change in endurance of the extensor muscles of the spine and a postexperiment survey was unable to distinguish between wearing a belt and not wearing one when asking the subjects about fatigue.

Effects on Intra-Abdominal Pressure

The idea of the back belt increasing intra-abdominal pressure is not a new one. The thought is that with the increase in intra-abdominal pressure during lifting with a back belt biomechanically supports and protects the extensors of the spine. The results indicate that endurance characteristics were the same with or without wearing the belt therefore throwing out the notion that the intra-abdominal endurance affects muscle endurance (7). However, this does not discount the probability that the increasing intra-abdominal pressure during rapid accelerating lifts may play a role in minimizing intradiscal pressure, thus preventing trauma to the back, without changes in endurance (2).

In a study by Harman, subjects wore a back belt while repeatedly lifting barbells while their intra-abdominal pressure was being measured (7). There were positive results that the intra-abdominal pressures rose in subjects who wore back belts. At first this seems as though the belts are doing as thought when actually it has been seen that increasing the pressure of the abdominal wall (such as performing a Valsalva maneuver) actually increased and not decreased the compressive load on the low back (7). Therefore, the conclusion that increasing the intra-abdominal pressure by wearing a back belt to reduce the compressive load on the low back seems entirely wrong.

Effects on Blood Pressure

The problem with this idea is that the increase in pressure does not necessarily stabilize the spine very well while causing a health problem for some people (10). If the employee has high blood pressure, it could cause it to rise. A group of researchers monitored the blood pressure and heart rate of five males and one female performing dead lifts and one-arm bench presses (10). The subjects were required to hold in a lifting posture a load of 40% of their maximum weight in the dead lift for two minutes. The subjects were required to breathe during the experiment to ensure that no Valsalva effect occurred. During the lifting exercises blood pressure (up 15mmHg max) and heart rate went up significantly higher in the subjects who wore weight belts (10). Understanding the relationship between elevated systolic blood pressure and stroke, it was concluded that the individuals who my have cardiovascular system compromise are probably at greater risk when undertaking physical exertion while wearing a back support than when not wearing them.

In a second experiment, the blood pressure of 20 young males performing sedentary and very mild activities both with and without a belt was analyzed (11). Wearing the belt significantly increased the diastolic blood pressure during quiet sitting and standing both with and without a handheld weight, during a trunk rotation task, and during a squat lifting task (11). As seen in both of these examples, blood pressure is negatively affected while wearing a weight belt. This said, care should be taken when wearing a belt, with the proper cardiovascular check-up before ever recommending a back belt.

The Effects on Spine Kinematics

The next idea concerning back braces is the effect on spine kinematics during lifting both large and small boxes (9). The purpose of this study was to determine if back belts change the employee's lifting style resulting in decreased spinal load along with affecting the end range of motion. The weight of both the boxes was equal, with only the size varying. The lifting setup was supposed to simulate the task of stocking shelves from a pallet.

The results of the experiment were that maximum spine flexion, right lateral bending, and left twisting were significantly reduced while wearing a belt and lifting a large box (9). Maximum flexion angular velocity and maximum extension angular velocity were also significantly reduced. Right and left hip maximum flexion and left knee maximum flexion increased significantly with the belt while lifting a large box (9).

The belt while lifting a small box resulted in significant reduction for maximum flexion (9). No significant effects were found for torso lateral bending or twisting. As in the large-box data set, both maximum flexion angular velocity and maximum extension angular velocity significantly decreased while wearing a belt and lifting a small box. Right and left hip maximum flexion and right knee maximum flexion increased significantly when wearing a belt.

The conclusion was that belt use while lifting both large and small boxes significantly affects spine kinematics by decreasing the ranges of motion stated above (9). The researchers mainly found that flexion is restricted when lifting both large and small boxes, although while lifting the smaller boxes there is no decrease in lateral bending or torso twisting. Interestingly, the researchers also found that the subjects had a tendency to use a squat-lift technique and lift more slowly while wearing a belt, regardless of the size of the box (9).

Psychophysical Aspects

Other ideas that will be expanded are the psychophysical aspect of lifting. This will investigate whether or not the employee thinks he/she can lift more, or even throw out the "proper" lifting methods that are often taught to employees (12). Although there is not much research on this, there was a study done by McCoy and colleagues. They examined 12 male students while they repetitively lifted loads from floor to knuckle height at the rate of three lifts per minute for a duration of 45 minutes. The subjects repeated this lifting sequence three times, once without a belt and once each with two different types of abdominal belts: a belt with an air bladder on the posterior of the belt and an elastic stretch belt (12). After examining the various magnitudes of loads that subjects had selected to lift in three conditions, the researchers noted that wearing belts increased the load that the subjects were willing to lift by approximately 19% (12). This evidence may give some support to the theory that belts give people a false sense of security.

Clinical Trials

First Clinical Trial

In 1990, Walsh and Stewards took 90 male warehouse workers randomly selected from over 800 employees at a grocery distribution warehouse center (13). After being selected they were separated and assigned to three different groups. One control group. A second group who received a 30 minute training session on lifting mechanics. A third group who received a 30-minute training session on lifting mechanics in addition to wearing low back belts while at work for a period of six consecutive months. The subjects chosen had pre-testing and 6-month follow-up post-testing for abdominal strength, cognitive data, work injury incidence and productivity and use of health care services were evaluated (13).

The type of belt that was used was different than the more common type of abdominal belts. The research group used an orthosis with hard plates, which were heat molded to the low back region of each individual (13). The hypothesis by the researchers was that wearing the belt would cause the abdominal muscles to weaken by doing the job of those muscles to take the load off the spine (13).

The researchers measured abdominal flexion strength of the workers both before and after the clinical trial. The control group and the training-only group showed no changes in abdominal flexor strength, along with no change in lost time from work (13). The third group, who had the training session and wore the belts, showed no changes in abdominal flexor strength or accident rate (13). The third group, however, did show a decrease lost time at work. The study did show that the only group who benefit from the decrease in lost time were individuals with previous low back injuries (13). This seems to indicate that there is some benefit from wearing a belt if the worker has had a history of low back injuries.

Second Clinical Trial

In 1998 Koes and Van Poppel performed a randomized control trial where 312 baggage handlers of an airline company were involved in a study for a period of six months (14). The subjects were randomly assigned into 4 groups: (1) education (lifting instructions) and lumbar support, (2) education and no support, (3) lumbar support and no education, (4) and no intervention (control group). The education consisted of 3 group sessions on lifting techniques with a total duration of 5 hours. The Lumbar supports were recommended for a period of six months.

All of the workers whose job description included manual material handling were invited to attend. The typical tasks of these employees are loading and unloading of cargo pallets and containers and the sorting of transportation cargo both manually and with a forklift truck. People with previous partial disability were excluded from this test. The subjects received monthly questionnaires on the occurrence of low back pain and sick leave. The subjects were asked if they have had low back pain in the past month, and if so, how many days they experienced the pain. The subjects also had to answer if they had missed any time due to the back pain and the number of days lost. This questionnaire was completed monthly during the experiment and was given as a follow-up at 9 months and 12 months.

The subject also had the strength of their abdominal muscles measured at the beginning (baseline), 6 months, and at 12 months following to see whether wearing a support affected their strength. The first test measured endurance in each subject by having him or her lay supine and hold in a curled posture for a maximum of 240 seconds (14). If the posture was lost, the amount of time was noted and recorded. The second test measured the dynamic strength of the abdominal muscles by having the subject perform 3 series of 5 sit-ups with increasing difficulty. The number of sit-ups completed by each subject was recorded.

The results of the trial were similar in the results obtained by Walsh and Schwartz. The post-trial abdominal strength tests showed no significant difference when compared to the pre-trial abdominal strength tests (14). Lumbar supports were shown to be not effective in the prevention of low back pain and sick leave in this study, with a similar number of days lost from work being reported (14).

The authors stated that based on the results of the study they would not recommend education or the use of lumbar supports in the prevention of low back pain (14). It is also believed that in order to judge the effectiveness of low back belts for manual laborers, a larger investigation into the possible benefits must be completed to get a fair representation of the possible results.

Third Clinical Trial

Mitchell and Lawler conducted a retrospective survey study of 1316 workers who performed lifting activities at Tinker Air Force Base (TAFB), Midwest City, Oklahoma (15). The study identified belt use, lifting requirements, injury, and treatment history. TAFB enforces the following policies regarding the use of back belts by employees. "A back belt will be provided to each worker at his/her request who lifts, pushes or pulls items which weigh or require a force to move over 20 pounds more than 50% of the work shift and who at his/her request a back belt" (15). However, TFAB "requires the use of back belts if an employee lifts items weighing over 20 pounds more than 50% of the work shift and has sustained a back injury or strain within the past 2 years" (15). Along with these requirements, TFAB has a policy that all new employees receive back injury prevention training during new employee orientation.

Each employee/subject were employed as warehouse workers in the material storage area, central receiving area, air freight, packaging and preservation, and the engines area. These employees were all employees who had a high proportion of lifting duties in their job description. It was estimated that the shape or size of the lifting requirements was consistent throughout the subjects surveyed. The employees were then broken into two groups: one group of employees who were chosen to wear a belt, and a control group who chose not to wear a belt. If belts were issued to an employee based on TFAB policy, the employee's supervisors were instructed to mandate their correct usage on a daily basis.

The results of this study showed that the main factors that related to the first back injury during the study period were if the individual had previous back problems. It also depended on the amount of weight that the individual lifted per day (1% for each 10 kg lifted per day) (15). The main factor was not whether or not the individual was wearing a back belt. One interesting result was the cost of back injuries that occurred when wearing a belt compared to when not wearing a belt. The authors noted that the cost of the injuries suffered while wearing a belt were significantly higher than the injuries suffered while not wearing a belt (15). This is something to be considered by a large corporation when they are looking at saving money.

The authors of this study believe that there might be some level of effectiveness in preventing an initial injury (15). This said, workers who are involved in continuous heavy lifting might receive some benefit from wearing a back belt to prevent initial injury. When looking at the spectrum of all the workers as a whole, the belt's effectiveness in both prevention and cost containment is not apparent, regardless of their history of back injury. As a result, the authors believe there should be caution taken before ordering a full-scale mandated back belt work policy.

Fourth Clinical Trial

In 1996, Kraus and Schaffer surveying the low back injury rates from 1990 through 1994 published a study of about 31,000 material handlers employed in all Home Depot retail stores in California (16). Each employee's work hours were classified by sex, age, length of employment and materials-lifting intensity determined from job title and ergonomic analyses. During this 5-year period, the Home Depot made it mandatory that all employees who are involved in materials handling wear back belts (16).

Due to the fact that almost all store employees lift or carry home improvement materials as part of their routine job tasks, the employees were broken into three different groups (16). The amount of lifting was classified into low, moderate, or high. The low lifting/carrying intensity group seldom requires lifting or carrying materials, and when they do, the items are seldom over 10 pounds in weight. The moderate lifting/carrying intensity group occasionally or frequently require lifting or carrying objects generally less than 25 pounds in weight. The high lifting/carrying intensity group frequently or continuously require lifting or carrying objects over 50 pounds.

Each injury claimed had a record kept with the date it occurred for any injury to the musculoskeletal elements of the trunk. These included injuries to the neck, shoulders, upper back, chest, ribs, thorax, mid-back, lower back, hips, pelvis, abdomen, groin and buttocks. Each injury claimed was then reviewed by two of the study investigators to verify inclusion criteria that included injury to the low back region along with a diagnosis by a physician (16).

During the study period, there were 1,760 low back injuries meeting the criteria described above (16). The incidence rate was significantly higher for men and was significantly greater than women for serious low back injuries. It is seen in the results that the positive factors for low back injury appear to be male sex and older age. Over 60% of all low back injuries were reported to be associated with lifting activities (16).

In the study, there was not a non-belt-wearing group to compare the people who wore the belt. This meant that Home Depot had to analyze their old rates of low back injury with the ones over the 5-year period of 1990-1994. When doing this, the authors claim that belt wearing reduced the incidence of low back injury in younger males and workers over 55 years of age. However, with no control group, it is hard to substantiate the claim that the back belts decreased the incidence of low back injury. Also to note, during the same time as the test was being conducted, Home Depot also increased the use of pallets and forklifts, installed mats for cashiers, implemented postaccident drug testing, and enhanced worker training, showing a general attempt to enhance overall safety of the company (17).

Fifth Clinical Trial

In 2000, Wassel and Gardner published a prospective cohort study of 13,873 material handling employees with the help of the National Institute for

Occupational Safety and Health (6). Between April 1996 and April 1998, 50 new stores, and 110 newly expanded stores of a major retailer were enrolled on the day they first opened for business. Eighty-nine of the stores required back belt use, while 71 stores had voluntary back belt use. In the stores that had a voluntary belt policy the employees were free not to wear the back belts without violating store policy (6). This would allow the individuals who did not wear belts to be compared to the individuals who were required to wear back belts.

The data was collected over the telephone by trained interviewers. The participants were called at the store during regular working hours. The questions in the baseline and follow-up interview included information about belt wearing habits, medical history, demographic information, work history, lifestyle habits, and job history. The individuals also were asked 4 job satisfaction questions from the Quality of Employment Survey developed by the US Department of Labor and NIOSH (18). This was to help factor in psychosocial factors that could be a cause for low back pain (18).

The data on all injuries were kept with the date of the injury and the characteristic of the job that was being performed at the time of the injury. The data included all claims received, regardless if it was accepted or not for compensation. All the back injuries that were unrelated to material handling (such as tripping or a fall) were excluded from the data.

The results found by the authors show no protective effects comparing employees who wore back belts usually every day with employees who never wore back belts for injury claims or low back pain (6). They also found there were no protective effects of the belt when comparing employees who wore belts once a week with employees who never wore belts for either back injury claims or low back pain (6). The strongest risk factor for low back pain in both the non-belt and belt wearing groups was a history of previous back injury (6).

The results also showed there was no difference in back injury claims between the individuals who were employed at a store with a mandatory belt policy when compared to workers at a store with a voluntary policy where they wore belts. Interestingly, while the amount lifted seems to be one of the biggest factors in low back injury, there was no difference in the back pain of those who wore belts usually every day and those who did not wear belts and lifted heavy loads (6).

These results prompted the authors to say that there is no evidence to support the use of back belts as a preventative measure (6). The authors found no effects of belt wearing among the subgroups as well. Employees with and without a history of previous back injury, employees with consistent self-reported belt wearing habits and employees with the most strenuous jobs all saw no benefit from wearing a back belt (6).

Conclusion

Comparing the Clinical Trials

While all of the studies had their own benefits, it was noted that the study done by Wassel was the most thorough. The authors of that study had a control group, a group wearing the belts, and another group that was given their own option of wearing a belt. All of the employees showed no benefit to wearing a belt. The study by Kraus did not have any control group nor did it screen for the individual risk factors that Wassel's study did. Basically, Minor states it best, "The epidemiological data concerning the efficacy of back belts in the prevention of occupational low back injuries are not sufficient to warrant general use of back belts in the occupational setting for injured or uninjured workers" (19). With the rates of occupational low back pain doubling in the past 10 years, it is imperative that a solution is found to slow the progression of what seems to be a growing problem (20).

Prescription Guidelines

The literature that has been completed regarding the use of back belts can neither support nor condemn the wearing of abdominal belts in an occupational setting. Given the literature, it would appear the universal recommendation of belts to all industrial workers is not in the best interest of globally reducing both the risk of injury and compensation costs. Uninjured workers do not seem to enjoy any benefit from wearing a belt and could be possibly be exposing themselves to the risk of a more severe injury if they were to become injured. However, it seems as some authors endorse the use of a belt if some individual workers perceive a benefit from belt wearing, they should be allowed to wear a belt conditionally but only on a trial basis. The mandatory conditions for prescription are as follows according to McGill (17):

1. Given the concerns regarding increased blood pressure and heart rate and issues of liability, all candidates should be screened for cardiovascular risk by medical personnel (17).
2. Given the concern that belt wearing may provide a false sense of security, belt wearers must receive education on lifting mechanics. Many times, belts are being promoted to industry as a quick fix to the injury problem. Promotion of belts in this way is detrimental to the goal of reducing injury as it redirects the focus from the cause of the injury. Education programs should include information on how tissues become injured, techniques to minimize musculoskeletal loading, and what to do about feelings of discomfort to avoid disabling injury (17).
3. Consultants and clinicians should not prescribe belts until they have conducted a full ergonomic assessment of the individual's job. The ergonomic approach should examine and attempt to correct the cause of the musculoskeletal overload and provide solutions to reduce the excessive loads. In this way, belts should only be used as a supplement for a few individuals, while a greater plant wide emphasis should be on the development of a comprehensive ergonomics program (17).
4. Belts should not be considered for long-term use. The objective of any small-scale belt program should be to wean workers from the belts by insisting on mandatory participation in comprehensive fitness programs and education on lifting mechanics, combined with ergonomic assessment. Furthermore, consultants would be wise to continue vigilance in monitoring

former belt wearers for a period of time following belt wearing, given that this period appears to be characterized by an elevated risk of injury (17).

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