A Review of the Use of Lifting Belts

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Summary

This manuscript reviews the literature on the effects of the use of back belts in industrial and strength and conditioning applications. Although the results are mixed, the preponderance of evidence supports some use of back belts during resistance training.

One of the more controversial issues in both industrial and strength and conditioning settings centers around the use of a device known as the lifting belt, weight belt, or back belt. A recent survey of health club members determined that 27% were lifting belt users. Ninety percent of those who used a lifting belt reported doing so to prevent injury, whereas 22% wore one to improve performance (8). However, questions remain as to the effectiveness of a lifting belt on lifting performance in either occupational or strength and conditioning settings.

In the last several years, consumer and coaching publications (5, 10, 14, 18) and literature reviews (9, 11, 20–22) have examined the use of the lifting belt. With the exception of the literature review by Genaidy and Simmons (11), who suggest that lifting belts can reduce load on the lumbar spine, most reviews assessing the use of lifting belts in occupational settings report that there is insufficient evidence to recommend their use (20, 21). Furthermore, lifting belts reduce lumbar motion but do not appear to reduce electromyography (EMG) of the erector spinae and abdominal oblique muscles or increase interabdominal pressure (IAP), therefore offering insufficient reason to recommend them for industrial workers (22). A review by Frankel and Kravitz (9) notes that industrial and fitness settings differ, as do laboratory and applied fitness settings, and that use of the lifting belt may be appropriate in some cases. However, industrial settings do not replicate gym conditions because loads are typically lower and exercise or exertion duration is typically more endurance-oriented.

In an attempt to empirically determine the effectiveness of the lifting belt, a number of studies have been conducted, with results appearing in occupational (3, 6, 12, 16, 18, 23, 24, 26–28) and sports science (1, 2, 4, 7, 13, 15, 17, 25, 29) research publications. Tables 1 and 2 summarize the results of the occupational and sports science research studies, respectively. Collectively, these studies have attempted to assess the effect of wearing lifting belts by examining a number of variables including the effect of lifting belts on incidence of injury, hemodynamics, IAP, spinal compression, range of motion, EMG of trunk muscles and prime movers, fatigue, and resistance training exercise performance. The purpose of this article is to review the research evaluating the use of lifting belts and to summarize the data so recommendations related to lifting belt use can be made.

Effect of Lifting Belts on Incidence of Injury

All of the research investigating the incidence of injury associated with lifting belt use or nonuse has been conducted in occupational settings. Studies have examined the incidence of injury with and without belts, as well as a cost analysis of injuries sustained with or without using a belt (16, 23, 28). Results demonstrate the use of the lifting belt was either marginally effective at lowering the rate of injury (16, 23) or had no effect (28). According to Wassell et al. (28), based on 9,377 subjects completing baseline interviews,
Table 1
Summary of Occupational Weight Belt Research Studies

<table>
<thead>
<tr>
<th>Author</th>
<th>Publication</th>
<th>Category</th>
<th>Independent variables</th>
<th>Dependent variables</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bobick et al.</td>
<td>Appl. Ergonomics</td>
<td>CV and respiratory</td>
<td>30-min lifting session with or without belt</td>
<td>HR, O₂ consumption, BP, respiratory frequency</td>
<td>No effect. Belt wearing had no effect on any of the assessed variables except for overall mean O₂ consumption</td>
</tr>
<tr>
<td>Cireillo et al.</td>
<td>Spine</td>
<td>Lumbar fatigue</td>
<td>Floor to 76.2 cm lifting and lowering task, repeated</td>
<td>Belt use, lifting with and without the belt</td>
<td>No effect. Back extensor EMG the same for each condition after 4 hours of lifting either with or without the belt</td>
</tr>
<tr>
<td>Giorcelli et al.</td>
<td>Spine</td>
<td>ROM and velocity</td>
<td>Lifting large or small box from 79 cm, 60 degrees to the right</td>
<td>Amount of torso lateral bending, spine flexion, hip and knee flexion torso twisting, and velocity</td>
<td>Reduced ROM. Subjects with belts lifted more slowly and used more of a squat technique employing more knee and hip flexion. Belts reduced torso motions</td>
</tr>
<tr>
<td>Majkowski et al.</td>
<td>Spine</td>
<td>EMG and strength</td>
<td>Lifting tasks with and without the belt using a LIDO lift 10 times/min for 20 min</td>
<td>EMG of paraspinals and isometric force during lift</td>
<td>No effect. Back belt had no effect on muscle fatigue or isometric lifting force</td>
</tr>
<tr>
<td>McGorry et al.</td>
<td>Spine</td>
<td>Lumbar and pelvis ROM</td>
<td>Lifting with and without the valsava with elastic, rigid, and no belt conditions</td>
<td>Trunk and pelvis displacements</td>
<td>Reduced ROM. Lumbar ROM significantly decreased with belt use during both lifting and lowering</td>
</tr>
<tr>
<td>Mitchell et al.</td>
<td>J. Occupat. Med.</td>
<td>Occupational back injury</td>
<td>Belt use, lifting requirements, and tx hx</td>
<td>Cost of belts, injury, and lost or limited work days</td>
<td>Mixed results. Use of back belt is marginally effective at reducing injury. Cost analysis shows less intensive injury and lower cost per injured worker without the belt</td>
</tr>
<tr>
<td>Miyamotto et al.</td>
<td>Conference Proceedings</td>
<td>Trunk cross section assessed by CT scan</td>
<td>With and without valsalva</td>
<td>Trunk cross section assessed by CT scan</td>
<td>Possible benefit. Round trunk cross section may mean that intramuscular pressure in the erector spinae is increased</td>
</tr>
<tr>
<td>Reddell et al.</td>
<td>Appl. Ergonomics</td>
<td>Injury risk</td>
<td>Wearing belts, not wearing belts, and injury rates after D/C belt use</td>
<td>Incidence of low back injury</td>
<td>Increase injury risk. Injury risk among baggage handlers was greater among those who had worn a belt but discontinued its use</td>
</tr>
<tr>
<td>Soh et al.</td>
<td>Appl. Ergonomics</td>
<td>Respiration</td>
<td>During repetitive lifting with 3 different belts, nylon, inflatable, elastic vest</td>
<td>Frequency of respiration</td>
<td>No positive effect. Frequency of respiration increased at rest with belt use and during lifting task. The nylon back belt demonstrated this effect more so than other types of belts</td>
</tr>
<tr>
<td>Warren et al.</td>
<td>J. Orthop. Sports Phys. Ther.</td>
<td>EMG (abdominal obliques)</td>
<td>Kin-Com machine squat lift with and without belt</td>
<td>EMG (abdominal obliques)</td>
<td>Reduced EMG. Mean EMG values lower with the belt than without. However, 5 of 6 male subjects demonstrated increased EMG while wearing the belt</td>
</tr>
<tr>
<td>Wassell et al.</td>
<td>JAMA</td>
<td>Occupational back injury; back injury claim rates and back pain</td>
<td>Belt use frequency and store policy</td>
<td>Injury rate and reported back pain</td>
<td>No effect. Neither frequent back belt use nor store policy requiring belt use was associated with reduced incidence of back injury claims or low back pain</td>
</tr>
</tbody>
</table>

BP = blood pressure; CV = cardiovascular; CT = computed tomography; EMG = electromyography; D/C = discharge; ROM = range of motion; tx hx = treatment history; HR = heart rate.
<table>
<thead>
<tr>
<th>Author</th>
<th>Publication</th>
<th>Category</th>
<th>Exercise examined</th>
<th>Independent variables</th>
<th>Dependent variables</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aursianian</td>
<td>Masters thesis</td>
<td>Spinal compression</td>
<td>Asymmetric lifting</td>
<td>Lifting with and without the weight belt</td>
<td>Spinal compression in addition to other variables</td>
<td>Possible benefit. Use of the weight belt reduced spinal compression in addition to other variables</td>
</tr>
<tr>
<td>Bauer et al.</td>
<td>J. Strength Cond. Res.</td>
<td>EMG</td>
<td>Back squat with 6 reps @ 60% of the 1RM</td>
<td>Squat with and without the belt</td>
<td>EMG of erector spinae</td>
<td>Possible benefit. EMG was greater when the belt was used</td>
</tr>
<tr>
<td>Bourne et al.</td>
<td>Br. J. Sports Med.</td>
<td>Spinal shrinkage</td>
<td>Circuit weight training</td>
<td>Circuit weight training, 1 sequence with and 1 without the belt</td>
<td>Spinal shrinkage as measured by a stadiometer</td>
<td>Possible benefit. The circuit training sequence resulted in a stature loss of 3.59 mm without the belt and 2.87 with the belt</td>
</tr>
<tr>
<td>Escamilla et al.</td>
<td>Med. Sci. Sports Exerc.</td>
<td>EMG</td>
<td>Sumo and conventional deadlift</td>
<td>Deadlifts with and without the belt</td>
<td>EMG of rectus abdominus and obliques</td>
<td>Mixed results. EMG activity was greater in the rectus abdominus when the belt was used. EMG activity was greater in the external obliques when the belt was not used</td>
</tr>
<tr>
<td>Finnie</td>
<td>J. Strength Cond. Res.</td>
<td>Motivations for use</td>
<td>None</td>
<td>Qualitative study</td>
<td>27% used belts, 90% of belt users used them to prevent injury. 22% used them to improve performance</td>
<td>27% used belts, 90% wore belts to prevent injury. 22% wore belts to improve performance</td>
</tr>
<tr>
<td>Harman et al.</td>
<td>Med. Sci. Sports Exerc.</td>
<td>IAP, GRF, lifting mechanics</td>
<td>Deadlift @ 90 1RM</td>
<td>Deadlift performed with or without belt</td>
<td>IAP, GRF, lifting mechanics</td>
<td>Possible benefit. IAP rose significantly with the belt. Peak and average IAP higher with the belt. Increased IAP thought to decrease disc compressive force</td>
</tr>
<tr>
<td>Hunter</td>
<td>J. Appl. Sports Sci. Res.</td>
<td>HR and BP</td>
<td>Bicycle ergometer, isometric dead lift, 1 arm bench press</td>
<td>Effect of weight belt during exercise on a bicycle ergometer, unilateral bench press, and isometric deadlift</td>
<td>HR and BP</td>
<td>Mixed results. WB resulted in higher systolic BP and HR for aerobic and isometric activities. Significant HR increase during the aerobic exercise</td>
</tr>
<tr>
<td>Lander et al.</td>
<td>Med. Sci. Sports Exerc.</td>
<td>Velocity, GRF, IAP, EMG</td>
<td>Squat</td>
<td>8RM squat with and without the belt</td>
<td>Velocity, GRF, IAP, EMG</td>
<td>Possible benefit. WB repetitions performed with more velocity, especially during later reps; WB IAP was greater</td>
</tr>
<tr>
<td>Reilly</td>
<td>J. Sports Sci.</td>
<td>Spinal shrinkage perception of effort</td>
<td>Deadlift 8 sets of 20 reps with 10 kg</td>
<td>Deadlift sets performed with and without the weight belt</td>
<td>Intervertebral disc shrinkage</td>
<td>Possible benefit. Mean shrinkage was greater when no belt was worn than when the belt was worn</td>
</tr>
<tr>
<td>Zink et al.</td>
<td>J. Strength Cond. Res.</td>
<td>EMG and kinematics</td>
<td>Back squat at 90% 1RM</td>
<td>Squat with and without the belt</td>
<td>EMG of 5 muscle groups kinematics (barbell velocity, etc.)</td>
<td>No effect. NSD in EMG between groups WB group performed the exercise with more velocity</td>
</tr>
</tbody>
</table>

IAP = interabdominal pressure; HR = heart rate; BP = blood pressure; 1RM = 1 repetition maximum; EMG = electromyography; GRF = ground reaction force; WB = weight belt; NSD = no statistical difference.
there were 195 back injury claims. Among the 6,311 subjects who completed baseline and follow-up interviews, there were 1,088 cases of back pain, with no statistically significant difference between those who did and did not wear belts. However, Mitchell et al. (23) indicated that there were less extensive injuries and lower costs per worker when the belt was not worn, despite a modest decrease in overall rate of injury associated with belt use. The effect of lifting belt use on incidence of injury in occupational settings remains inconclusive.

Effect of Lifting Belts on Fatigue
Studies of the effect of belt use on fatigue have primarily examined repetitive simulated occupational lifting tasks. In one study (6), EMG was assessed in back extensors near the end of a 4-hour lifting task performed with and without the belt. Difference in back extensor EMG between the 2 conditions was not statistically different, leading the authors to conclude that the belt did not attenuate lumbar fatigue (6). Similarly, Majkowski et al. (19) found that the lifting belt had no effect on muscle fatigue in the paraspinals, as evidenced by no differences in EMG.

Effect of Lifting Belts on Hemodynamics
In addition to assessing the effect of weight belt use on injury rate and fatigue, some studies have evaluated the effects of the lifting belt on hemodynamic variables. Bobick et al. (3) demonstrated that use of a lifting belt during a 30-minute simulated occupational lifting session had no effect on heart rate (HR), blood pressure (BP), and frequency of respiration. Only mean oxygen consumption was affected, as evidenced by a small increase associated with lifting belt use. In contrast, another study of repetitive simulated occupational lifting assessed the use of 3 different types of lifting belts and found that frequency of respiration did increase with the use of lifting belts (26).

Effect of Lifting Belts on EMG
A number of studies have assessed average EMG of trunk muscles during simulated
occupational lifting tasks using machines, as well as during the performance of resistance training exercises. For example, Warren et al. (27) demonstrated that for all subjects who performed simulated occupational tasks, mean EMG values of the abdominal obliques were lower while wearing a lifting belt, with average EMG values of 29.7 ± 3.13 mV compared with 33.3 ± 3.05 mV in the lifting belt and nonlifting belt conditions, respectively. This finding was particularly true for female subjects. However, 5 of 6 male subjects demonstrated higher average EMG values while wearing the belt. The results of a study by Escamilla et al. (7) are similarly equivocal regarding the question of the effect of lifting belt use on trunk muscle EMG (EMG data was normalized and averaged). In this study, researchers found that during the performance of the sumo and conventional deadlift, subjects who did not wear lifting belts demonstrated greater EMG activity in the obliques when compared with subjects who wore belts, as evidenced by EMG values of 53 ± 21% maximal voluntary contraction (MVC) for subjects wearing the lifting belt and 62 ± 26% MVC for those who did not. However, the same study showed that the use of the belt resulted in more EMG activity in the rectus abdominus when compared with those subjects who did not wear belts. Subjects who wore the lifting belt demonstrated 63 ± 32% MVC compared with 56 ± 26% MVC for those who did not. Other researchers have used median power spectral frequency EMGs to assess trunk muscles and the effect of muscle fatigue of subjects who performed a repetitive lifting task (19), with results indicating that the lifting belt had no effect on muscle fatigue.

In addition to EMG studies during simulated occupational lifting tasks, researchers have examined the effect of the lifting belt on trunk muscles and prime mover motor unit activity during the back squat. Results reveal no significant difference in EMG of erector spinae and other hip and knee extensors between lifting belt and nonlifting belt conditions (29). Although exact numerical data are not shown, the accompanying figure suggests that lifting belt and nonlifting belt conditions were approximately within 1–4% of each other, with all values in a range of 52–57% of peak EMG. Nonetheless, other evidence suggests that use of the lifting belt increases EMG of prime movers such as the vastus lateralis and biceps femoris (although the trunk muscles showed no effect here; 17), and as much as a 23% increased EMG of muscles such as the erector spinae (2), when comparing lifting belt use to nonuse.

### Effect of Lifting Belts on Resistance Training Exercise Performance

Some evidence suggests that repetitions of an exercise are performed with more velocity when the lifting belt was used (17, 29), although use of the lifting belt may not promote an increase in force (19). Two studies demonstrated that the use of the lifting belt increases velocity of the squat. For example, Zink et al. (29) reported that squats are performed with a higher velocity when the belt is used. In their study, when lifting belts were used, squats were performed in an average time of 2.96 ± 0.65 seconds compared with 3.21 ± 0.77 seconds when performed without the lifting belt. Also, according to Lander et al. (17), 8 repetition maximum (8RM) squats were performed with more velocity, especially during later repetitions in the set, for those who wore the lifting belt. Repetitions performed with the lifting belt took an average of 3.34 seconds compared with 3.56 seconds without the belt.

### Discussion

Lifting belts seem to affect range of motion, although it is hard to say what advantages this affords, if any. In simulated industrial applications, altered range of motion may increase the likelihood that subjects would use a squat-lifting technique, thus flexing more at the knees and hips to lift heavy objects (12), which would seem desirable. Nonetheless, studies evaluating actual injury rate in occupational settings are inconclusive (16, 23, 28). Furthermore, the lifting belt does not appear to reduce the rate of lumbar fatigue during occupational activities (6, 19). Thus, the occupational research sheds little light on the use of the lifting belt for strength and conditioning purposes, and no studies have specifically evaluated the incidence of injury associated with lifting belt use or nonuse in strength and conditioning settings despite the fact that some evidence suggests that most wearers use them to prevent injury (8).

Lifting belts seem to have no negative effect on hemodynamic variables such as HR and BP (3), with the only exception occurring during a study of isometric deadlifts (15), which are an unlikely exercise option in most strength and conditioning settings. Additionally, no evidence exists to implicate resistance training hemodynamic responses with possible injury, even if those responses were higher than normal. As commonly believed, IAP increases with the use of the lifting belt, which most likely serves to reduce spinal compression during the performance of a variety of resistance training exercises (1, 4, 25).

The significance of the effect of the lifting belt on motor unit recruitment as evidenced by changes in EMG activity depends on whether it is an occupational or strength and conditioning setting. In occupational settings, less muscle activation may be desirable in order to reduce fatigue, thus reducing joint reaction forces. In strength and conditioning settings, more motor unit activity represents a better training stimulus and is desirable. Previous anecdotal claims suggest that belt use reduced the training effect of the trunk muscles (5, 10). However, EMG studies are inconclusive. Studies suggest that the effect of lifting belts may depend on the trunk muscle studied (7) and gender (27). In fact, some evidence suggests that there is more
erector spinae EMG activity associated with wearing the lifting belt (2) and that there is more EMG activity associated with the prime movers during the squat while wearing the lifting belt (17). This finding may be part of the reason that studies demonstrate increased velocity of exercises such as the squat (17, 29) when lifting belts are used.

In summary, the literature suggests a general lack of evidence indicating the benefits of wearing lifting belts in industrial and occupational settings. The sport science and strength and conditioning literature suggests there is no strong argument against the use of the lifting belt. Five of 8 studies of lifting belt use in sport science and strength and conditioning applications suggest that lifting belt use may provide some benefit. Sport science evidence suggests that lifting belts may be beneficial in reducing spinal compression, stabilizing the spine, increasing motor unit recruitment in prime movers, and increasing exercise velocity. Two of the 8 sport science and strength and conditioning studies showed mixed results. Only 1 of the 8 studies showed no positive effect.

Several questions remain regarding lifting belt use. The evidence in the occupational settings reveals little to no positive effects via the use of lifting belts, but the sport science/strength and conditioning body of evidence shows enough positive effect that further study is warranted.

References

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