

What injuries are attributed to the deadlift?

The deadlift is a popular weight-training (WT) exercise that can help improve overall body performance and strength in the lower body by activating muscle, tendons, and joints in the legs, hips, buttocks, and lower back. This lift can also improve core and upper body muscle strength. In certain cases, however, stress on the knees and lower back regions may lead to injury.^{1,3}

Most **deadlift** injuries are to **lower body** musculoskeletal (MSK) tissues.¹⁻⁴ Injuries occur either instantly from abrupt high force movements ([acute traumatic injuries](#)) or gradually from repeated lower intensity movements ([overuse injuries](#)).³⁻⁶ Repeated or untreated injuries can lead to chronic MSK conditions.^{3,6}

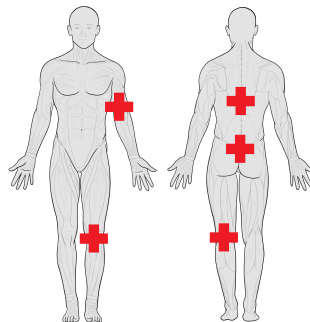
Injuries are most frequently to muscles, tendons, and joint tissues (meniscus, ligaments, cartilage and disc) of the **knee and lower back** (including the lumbo-pelvic region).¹⁻⁴ Less frequently, injuries to the upper leg (hamstrings), as well as upper arm and shoulder have been reported.¹⁻³

Acute injuries associated with the deadlift include:

- Ruptures, tears, and strains of muscles and tendons (knee and back)
- Joint sprains (knee)
- Herniated disc (back)
- Fractures (spine)

Overuse injuries and chronic conditions include:

- Low back, hip, knee pain
- Nerve pain or numbness (sciatica)
- Bone damage (stress fractures and arthrosis)
- Long-term back/spinal pain and spondylolysis



Use of the Hex bar during the deadlift; Photo courtesy of APHC

How are deadlift injuries caused?

The deadlift requires lifting a weighted barbell off the ground until the lifter is standing erect. Injuries are attributed to a combination of high loads (heavy weights) and improper form.¹⁻³ Too much forward lean, especially if a barbell is too far from the body, increases the force on the back. Standing too quickly and/or fully locking knees (stiff-leg or straight-leg) may increase damage to knee tissue or hamstring.^{1,3} Using a Hex bar, as required for the ACFT (shown above), minimizes risk by keeping the weight closer to the body which reduces force on the spine.⁷ Activities such as the deadlift cause small tears in MSK tissue that must be repaired and remodeled to build strength. Overuse injuries occur when the body has inadequate time to repair this damage.⁶ This results from using weights that are too heavy, overdoing the time spent on deadlifts, squats and other lower WT workouts, and other factors (see below).

What can increase your risk of deadlift injuries?

Though quantitative evidence is limited, various observational and descriptive studies¹⁻³ suggest the following may predispose Soldiers to deadlift injury:

- Inappropriate training principles: Insufficient warm-up, intense acceleration, excessive repetitions/weight.
- Improper technique: Uncontrolled movements, hips moving above the shoulders, excessive shoulder rounding, knees collapsing inwards, dropping weights.
- Muscle fatigue: Tends to shorten joint movement reducing the efficiency of the body's movement.
- Imbalanced training: Over-training and building major muscle groups (e.g., hamstrings, quadriceps, trapezius, "lats") while undertraining stabilizing muscles (e.g., abdominals, erector spinae) can cause spinal instability.
- Anabolic steroid use: Building muscle power beyond the tendon capacity increases susceptibility to tears.
- Equipment: Use of straight bar increases stress on back. Back and knee braces have not been shown to prevent WT injuries. Back braces may even increase risk.^{4,11}

Why do deadlift injuries concern the Army?

Strength training is an important element of a Soldier's fitness program.⁷ The 3-repetition maximum deadlift (3RM, maximum weight that can be lifted in three consecutive lifts) is one of the six events of the Army Combat Fitness Test (ACFT).⁸ The Army has taken precautions to minimize injury risk associated with deadlift by requiring the use of a Hex bar instead of a straight bar, weight collars, and a warm-up period prior to testing.^{7,8} To avoid encouraging lifts of excessive weight, the Army requires no more than 340 pounds to max the deadlift.⁸ However, some injuries are still expected to occur. Though certified personal instruction is best, general guidelines may help reduce some of the risks.

The knee and low back are the most frequently injured body regions among Soldiers.^{5,6,9-11} These injuries can require weeks of physical restriction and costly treatment. Though running and foot marching cause about half of the injuries, WT is the third leading cause (5 to 10% of injuries).⁸⁻¹⁰ The growing popularity of WT may increase these injuries.

How can deadlift injuries be prevented?

Because there are many individual variables associated with weight lifting (e.g., experience, training goals, body build, prior injuries), there is no single perfect technique or training program that best suits everyone. Additionally, evidence supporting the effectiveness of specific procedures to avoid deadlift injuries is limited. While Army doctrine^{7,8} provides basic techniques to safely perform the Deadlift using the Hex bar, individuals using free weights are advised to consult with an Army Master Fitness Trainer or Certified Fitness Trainer** for individualized training guidelines and program design. Additional best practices recommended by medical and fitness professionals to prevent injuries are provided below:

Suggested Guidelines to Avoid Deadlift Injury

- 1. Warm-up.** At the start of your workout, complete 10 minutes of light cardio and/or moving stretches (e.g., jogging in place, jumping-rope, sit-stands, or the 'preparation drill')⁷ to increase your blood flow and warm up joints. Also incorporate movements very similar to exercises during the planned training session; complete 1-2 deadlift sets with very light weights or empty Hex bar before your training sets.
- 2. Use a Hex bar.** Hexagon (Hex) or "trap bars" are required for the ACFT and available in Army fitness centers. Hex bars are designed to keep the weight more vertically aligned. This safer positioning engages the same lower body muscles as a straight bar but reduces force on the back while maximizing effort of the quadriceps.
- 3. Select an appropriate weight.** Choose light weight until you have practiced good form. When you have developed good form, choose a training weight that you are safely able to lift for the desired number of repetitions and sets. The number of "reps" in each set typically ranges from 6 to 12; the number of "sets" is typically 2 or 3. Use moderate weights with more reps (10 to 12) and sets (3) to improve muscle endurance. Use fewer reps (6 to 8) and sets (2) with heavier weights to increase muscle size and power. Gradually increase weights over time while maintaining good form (e.g., increase weight by 10% once you can safely complete your sets). Though as much as 360 pounds can be added on the 60 pound Hex bar (420 pounds), the ACFT is maxed by lifting 340 pounds.⁷ Always remember the risk of overuse injury from repeated stress on knees and back from deadlift and other WT lifts (such as the squat) over time.
- 4. Secure weight on the bar with weight clips or collars.** A slight tilt or imbalance from a slipping weight can cause injury, so it is important that the weight plates remain in place. Use clips/collars to prevent weight plates from shifting or slipping during a lift. These are required by the ACFT and most fitness facilities.
- 5. Ensure proper technique.** Guidance to safely conduct the Deadlift using a Hex bar is in FM 7-22.^{6,7} However, it is recommended that you obtain face-to-face instruction from a qualified trainer** to determine the form and weights best suited for you. Your form will be different if you choose to use a straight barbell, instead of the hex or trap bar. Your form may need to be adjusted for body structure, fitness level, or prior injury. General deadlift recommendations (for conventional stance) include:
 - Stand with feet shoulder-width apart, toes forward, lower legs with straight back (don't bend forward).
 - Grip bar (feet shoulder width), keep head up, eyes forward to horizon, and activate core (abdominal) muscles.
 - Inhale while lifting bar, keep back straight (don't round) to a stand, keep knees slightly bent (don't lock).
 - Lower bar, keeping it close to body (shins), bending back at hips – do not let shoulders go below hip level.
 - Do not drop or bounce weights on ground, doing so can lead to injury and results in ACFT termination.
- 6. Allow for muscle recovery.** Rest intervals between sets depend on training goals, but it is generally recommended to rest for at least 2–3 minutes between each set. Allow at least 48 hours between weight training sessions for any single muscle group such as those of the knees, hips, and back.
- 7. Use alternative equipment and/or exercises.** You can use dumbbells, typically using lighter weight, to build muscle strength and technique before training with a Hex bar. You can also train using only the Hex bar (60 pounds) prior to adding on weight plates. As an alternative to the conventional ("narrow") stance deadlift, the sumo stance requires a wider stance with hands inside the knees. For some, this position may alleviate back strain. Straight-leg and Romanian deadlifts with a straight bar may increase knee damage. See a qualified personal trainer** for technique guidance prior to using an alternative version of the deadlift. There are still risks of knee and back injuries when working the same muscles and similar movement patterns.

Information Sources:

1. Bengtsson *et al.* 2018. Narrative review of injuries in powerlifting with...association to the squat, bench press and deadlift. *BMJ Open Sport Exerc Med* 4(1):e000382.
2. Aasa *et al.* 2017. Injuries among weightlifters and powerlifters: A systematic review. *Br J Sports Med* 51(4):211-9.
3. Keogh *et al.* 2017. The epidemiology of injuries across the weight-training sports. *Sports Med* 47(3):479-501.
4. Strömback *et al.* 2018. Prevalence and consequences of injuries in powerlifting: A cross-sectional study. *Ortho J of Sports Med* 6(5):2325967118771016.
5. Jones *et al.* 2018. Musculoskeletal training injury prevention in the US Army: Evolution of the science and the public health approach. *JSAMS* 21(11):1139-46.
6. Hauschild *et al.* 2018. APHC Report 12-01-0717, A Taxonomy of Injuries for Public Health Monitoring and Reporting. <http://www.dtic.mil/docs/citations/AD1039481>
7. Department of the Army. 2012. Field Manual 7-22, Army Physical Readiness Training. <https://armypubs.army.mil/ProductMaps/PubForm/FM.aspx>
8. US Army. 2019. ACFT Field Testing Manual. https://www.army.mil/e2/downloads/rv7/acft/acft_field_testing_manual_final.pdf
9. Hauret *et al.* 2015. Epidemiology of exercise- and sports-related injuries in a population of young, physically active adults – military. *AJSM* 43(11):2645-53.
10. Schuh-Renner *et al.* 2017. APHC Tech Report S.0030637-17, Survey of Injuries and Risk Factors in 2nd Brigade Combat Team, 3rd Infantry Division, 2014-15.
11. Brooks *et al.* 2018. APHC Tech Report S.0048216-16, Epidemiological Investigation of the Rehabilitation Physical Readiness Training Program Baseline Survey.
12. Bullock *et al.* 2010. Prevention of physical training-related injuries: Recommendations for the military and other active populations. *AJPM* 38(1S):156-81.

** E.g., ACSM Certified Personal Trainer® (CPT), ACSM Certified Health Fitness SpecialistSM (HFS), ACSM Certified Group Exercise InstructorSM Certified Strength and Conditioning Specialist®, NSCA-Certified Personal Trainer® (NSCA-CPT), NSCA Tactical Strength and Conditioning-Facilitator (TSAC-F).
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