



What are foot marching injuries?

Terms used by the Army to describe activities associated with foot marching injuries include “ruck marches,” “forced marches,” “loaded marches,” “road marches,” and “patrolling.” During these activities as well as other training and operational activities, heavy loads are carried on the back in backpacks or rucksacks. Body armor, protective clothing, ammunition, and other supplies are also worn on other parts of the body. This load-carriage puts repeated stress on the body’s skin, bones, muscles and nerves and can cause numerous types of injuries. The lower extremities (knees, lower leg, ankles, feet) and back are most frequently affected. Specific injuries include: ^{1, 2, 4-6}

- Foot blisters (see APHC Blister Prevention factsheet*)
- Knee pain and various musculoskeletal knee injuries
- Back pain, strains, and other lower and upper back injuries
- Stress fractures to feet, lower leg, and pelvis
- Nerve compression injuries causing numbness, tingling, pain, weakness or temporary paralysis in:
 - Shoulder or arms (“Ruck sack palsy” or *Brachial plexus palsy*) from straps compressing neck/shoulder nerves
 - Thigh (*meralgia paresthetica*) from hip belts, harnesses or body armor
 - Feet (*metatarsalgia*) pain in middle or front of sole)
 - Toes (*digital paresthetica*)

Ankle injuries are also associated with foot marching activities, often as a result of acute strains, sprains, or fractures from slips, trips, and falls.* In addition, injuries may be attributed to environmental hazards including heat illness,* cold weather injuries,* and insect/animal bites. ²⁻⁵



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Why are these injuries a concern to the Army?

Because military mission success often depends on the efficiency by which personnel carry needed equipment over long distances, marching remains a core element of military training ^{1,2,4,6-8} Ideally, this training should enhance Soldiers performance, without increasing injury risk. Yet foot marching activities are a common cause of Army injuries. ^{1-3,6} Training loads typically range from 40 to >100 pounds, and distances of 2-12 miles. Speed may vary depending on terrain and time of day, though a common goal is 12 miles in 3 hours (4mph). ³ Yet improvements in weaponry, body armor and other carried equipment continue to add to the typical military load. ^{5,6} Loads averaged over 100 pounds in recent combat operations, and weights were higher for certain units, such as antiarmor or mortar teams. ⁹⁻¹⁰ Awareness of injury risk factors and prevention tactics can help reduce them.

What affects risk of foot marching injuries?

- Individual physical factors such as body size, bone structure, gender, age, prior injury, and fitness levels can put some people at greater risk of foot marching injuries. For example, those of smaller build, which often includes women, appear to be at greater risk of stress fractures. ^{1-3,5,6} Factors such as fitness or strength may be improved.
- Training program parameters. Proper training is considered a primary means to prevent foot march-related injuries. Key training factors include load weight, speed (pace), distance per session, and frequency (number marching sessions per week or month). ^{1-3,5,6} Increasing any of these factors too rapidly can increase risk of injury. Stresses can be exacerbated by types of terrain especially steep rocky hills, sand, or snow. ^{4,6} All of these factors should be considered in designing training for specific units and operations.



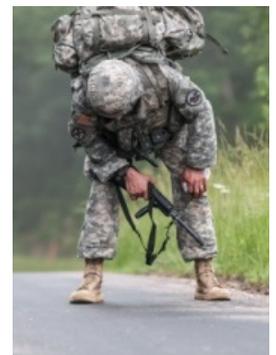
Photo: DVIDS

- Equipment. Ill-fitting or improper footwear can exacerbate the pressure and repetitive rubbing of skin on the feet, causing injuries. The rucksack worn on the back increases forward lean and may increase back injury risk. ¹⁻⁵ Different backpack designs can change load distribution. Though military pack options include front-back double packs which can reduce back strain, they are often not conducive to movements needed for military tasks. The Army recommends a lightweight external frame system (next page). However, the best equipment and distribution can depend on a persons size and the terrain (e.g. hills versus flat surfaces). ^{1-4, 6,10} Injuries can also occur if a pack is not correctly lifted or put on. Straps and belts can help redistribute load and reduce strain; however, excessive pressure from straps and armor can also cause injury.

How can foot-marching injuries be prevented?

While some factors cannot be changed, personnel can modify certain behaviors to reduce the chance or severity of marching and load carriage injuries ^{1,3} Examples include:

- Precondition: increase distance and weight progressively; practicing with proper equipment and boots ¹⁻⁷
- Keep feet dry and reduce friction: use synthetic socks instead of cotton; consider inner sock liners ¹⁻⁵
- Improve fitness: include a mix of aerobic and muscular strength and endurance exercises ^{1-5, 7}
- Use right equipment the right way: use properly fitted external frames and straps to redistribute load ^{2, 5, 11}
- Avoid tobacco: maximize health



See next page for additional prevention details

How You Can Prevent Foot-Marching Injuries

Though tactics, techniques, and equipment to reduce foot-marching injuries have not been thoroughly studied and proven across broad populations, the following are current guidelines to consider:

Reduce load and distance	<p>Excess weight increases injury risk and also reduces speed to get to a location, increases energy needs, and reduces combat performance.^{3,7} All Soldiers should limit loads to mission-essential items only. Decisions as to what equipment is essential and how to transport it <i>is best done at the lowest unit level possible</i>:</p> <ul style="list-style-type: none"> ▪ Senior leaders should avoid mandating set weights for everyone ▪ Unit leaders should minimize load weights and distances to the extent necessary, given the unit condition, mission, terrain, travel time, and distance ▪ Leaders should encourage use of vehicles and wheeled carts when possible and appropriate.
Use proper equipment and adjustments	<p>Use the best pack. Packs may have internal or external frames, or no frames. Frames can add weight, but help distribute loads. The Modular Lightweight Load-Carrying Equipment (MOLLE) pack is currently recommended for the Army.¹ It includes a main rucksack with lightweight external frame, adjustable shoulder straps, waist belt, and a vest with several pockets and detachable compartments to allow unit-specific customization.</p> <p>Adjust sternum, shoulder, and waist/hip straps, and armor for better load distribution to different parts of the body. For example, a properly adjusted hip strap can take 30% of the load, which can reduce strain on back. Proper use of the sternum straps can move strain to different parts of the shoulder and reduce the probability of <i>rucksack palsy</i>. Compression from straps or armor can also cause nerve injury or blisters, so pay attention to early signs of rubbing, strain, or numbness and adjust equipment as needed during march and when sitting (armor can press on thighs).^{2,5,11}</p> <p>Learn and follow proper technique to put packs on and off to avoid sudden shoulder and back injuries</p> <p>Place commonly used items to front pockets for easy access and minimize back load which will result in a more upright walking posture and may reduce back injuries.^{1-2, 4-5}</p> <p>Move locations of items in backpack based on the expected terrain.^{1,2}</p> <ul style="list-style-type: none"> ▪ <i>Even terrain</i>: Heavy items put high in the backpack may help one stay upright. ▪ <i>Uneven terrain</i>: Distribute load more equally to help keep the body stable. <p>Take care of your feet! Ensure boots fit (such as about ½ + inch from big toe to boot end, wide enough but not loose in heel); lace cross-ways, snug but not too tight; cut toenails short and square; wear clean cushioned well-fitting synthetic socks with nylon or polypropylene inner liners (seams/knots to outside); keep feet clean and dry (change wet socks); use coatings or taping covers for blisters; during rest breaks prop feet up, loosen laces, and massage if time permits.^{2,4} <i>Also see Blister Prevention and Cold Weather factsheets</i></p>
Precondition with an adaptive march training program	<p>Begin and add to foot march training programs slowly, and space sessions out at least weekly. Foot marching performance has been shown to improve with regular march training at least every two weeks in conjunction with aerobic and strength training. More than four marches per month may be excessive.^{7,8}</p> <p>Increase intensity (load weight) and distances slowly toward the goals expected for real-world operations and specific sub-unit mission. If speed is maintained (e.g., 4 mph), increase distance and weight of load on separate days by 10% each time. Running with carried loads will likely increase risk of injury, so speeds greater than 4 mph are not recommended.</p> <ul style="list-style-type: none"> ▪ Two to six months' time for initial activity to maximum distances and load weights is recommended to minimize injury for most units.⁶ However, unit mission, baseline fitness levels, other physical activities/training, terrain and climate should be factored into design of a march training program.^{5, 6} ▪ While studies have not yet provided adequate evidence to establish an Army-wide load march progression program,^{1,6} a suggested example for initiated trainees might include progressive distances of 2, 5, 10, 12 miles, alternating with progressive increase of loads (initial 10- 20 pounds, then to 40, 60 or more).
Maximize fitness and health*	<p>Engage in a balanced physical training program.^{1-6, 12} In addition to training marches, a combination of aerobic (running and low-impact elliptical, biking, or swimming) and muscle strength and endurance activities have been shown to improve road marching performance. Agility and balance drills are also recommended. Care must be given to avoid excessive distances and frequency of long runs and marches especially trainees.¹</p> <p>Follow healthy behaviors. Staying hydrated, wearing clothing or layers proper for the weather to avoid heat/cold injuries, and avoiding smoking can reduce risk of injury.^{1-3, 5} For example, evidence suggests that people who smoke have higher rates of certain types of injuries, including blisters.^{2,4}</p>



Courtesy of Wikipedia.org. From https://peosoldierarmy.mil/factsheets/SEQ_CICMOLLE.pdf

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* **OTHER RELEVANT APHC FACTSHEETS:** [Falls \(2015\)](#); [Heat Illness \(2016\)](#); [Cold Weather Injury \(2015\)](#) [Blister Prevention \(2015\)](#)