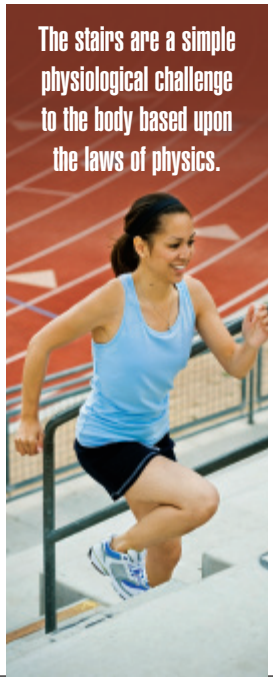
stair exercises

If you know someone who is overweight and trying to shed a few pounds, chances are they have been told to use the stairs more frequently for physical activity related weight loss; and if you're a personal trainer, you've likely been the one to make the recommendation. The stairs are a simple physiological challenge to the body based upon the laws of physics. Stairs combine vertical and horizontal displacement, thereby increasing the force demand beyond normal horizontal locomotion. Stair climbing's positive contribution to weight loss explains the popularity of the Stairclimber machines in the 90's and although the elliptical trainer has since replaced many of the traditional Stairclimbers, they are still commonplace in most gyms/fitness facilities.

It is important to recognize the difference between a stair stepper machine and actually using the stairs. The stair stepper machines do not require the same physical displacement as actual stairs because the peddles of the machine are depressed while the body remains relatively stationary rather than all the energy going to moving the center of mass upwards. In fact, efficient stair stepper practice keeps the exerciser in exactly the same place, so center of mass displacement is minimized. Although some differences exist, this is also true of the Guantlet StairClimber machine (works like an escalator). Even though the feet actually leave the machine, the vertical displacement is eased by a descending step position. Secondary to this fact, is that stair climbing using real stairs places much more challenge to posture through a changing closed kinetic chain. The stability requirements are much higher and consequently make the activity more functional for the purposes of human performance. The knock on the machines is the stability enhancement of the handrails and the pressing motion of the quads and hips require much less kinetic efficiency in the pseudo-closed chain environment. Likewise, the shorter range of motion changes the movement mechanics and subsequent recruitment patterns affecting functional transfer to real world applications.



The uniqueness of the stairs is that they better use the body's weight as a resistance than horizontal modalities. The angle and height allow the architecture be used in any energy system and for the purposes of any goal: simply climbing steps for an extended period of time is cardiovascular; run up the stairs with fast feet and you have an anaerobic (hip flexor) speed drill; bound up the stairs (skipping one or two steps) and you are working hip extension power; go up laterally and your frontal plane hip muscles are trained; hold a 45 lb plate over head and your core is the emphasis. It becomes increasingly obvious that using the stairs broadens one's work environment.

The implementation of the stairs must be purposeful and safe, and since the article started out with weight loss as a goal it makes sense to identify the actual effectiveness of stair climbing on obese individuals. In an article published in the *Journal of Endocrinology Investigation* (2002) researchers looked at tolerance and outcomes of morbidly obese individuals when using different anaerobic training techniques such as those commonly seen on the TV Shows such as "Biggest Loser". Investigators had 75 obese subjects (BMI >35) and 36 lean control subjects (BMI ~22) of the same age and gender distribution, perform different short-term anaerobic activities including jumping, sprint running and stair climbing. As expected the results show that obese subjects attained a significantly lower power output expressed per unit body mass both in jumping and stair climbing and also ran at a significantly lower average velocity during sprinting compared to lean individuals. Interestingly, the jumping and climbing tests were closely correlated, but the stair climbing demonstrated significantly higher absolute power output (18%) in the obese compared to the lean controls. During sprint running, the lower average horizontal velocity achieved by obese subjects was due to inefficient movement mechanics associated with shorter step length, lower frequency and longer foot contact time with ground. These findings suggest stepping is a good modality for overweight individuals over more ballistic activities. Obese exercisers prefer vertical changes over speed and low

impact over high impact which speaks to both exercise tolerance and safety. The results were similar in an article published in the *Journal of Diabetes, Nutrition, and Metabolism* (2003); and although obese individuals are partially hampered in kinetic movements from the disproportionate excess of inert fat mass, they can effectively perform anaerobic tasks and stair climbing is well tolerated. Furthermore, implementing body weight exercises over machines aimed at the same goal prove useful for improvements in ADL/weight loss programs for the obese.

When using stair climbing for improvements in power, strength, locomotive stability or weight loss in obese or deconditioned clients the emphasis should be on quality movement mechanics. The limited impact makes the stair climbing much more desirable over other anaerobic power activities such as running or jumping for heavy individuals, but the tendency to short step and dominate the movement with knee extension rather than hip extension can lead to patella-tendonitis and other overuse injuries. When aiming for more power, the technique requires a high chest position and alternating arm drive just like form running. If more emphasis is on the kinetic chain force coupling (knee-hip-trunk) and trunk stabilization, attempt to raise the center of mass. Folding arms behind the head or holding a medicine ball overhead both increase core requirements. A relatively easy progression is to move the weight over one shoulder for asymmetrically driven counter stabilization or carry a single-side water bucket and alternate sides between sets. Water buckets work very well because they can be filled to desired loads, travel well and can be used asymmetrically (double bucket carry) without being unilaterally loaded. Work to rest ratios can be as tolerated or a 1:3 - 1:5 ratio depending on load and distance travelled.

More advanced clients can take the stairs to a next level. Although holding a plate over head while stair climbing is effective, increasing the load and pace will increase the metabolic demands. Depending on the goal, the exercises may be high load/form dominant or low load/speed dominant. Heavier loads often require a single step distance whereas power and speed may use double step distances. Some examples of different stair climbing techniques include:

Weighted Stepping

Purpose: strength, power
Distance: single step; one to two flights
Load: barbell, grip plates, kettlebells, sand bags, water buckets
Speed: variable controlled (load dependent)

Weighted Overhead Stepping

Purpose: stability, kinetic chain efficiency
Distance: single step; one to two flights
Load: short barbell, single grip plates, medicine ball
Speed: controlled

Stair Bounds

Purpose: power
Distance: double or triple step (limb length dependent); one to two flights
Load: body weight, weight vest (<10% body weight), shouldered sand bag
Speed: fast

Speed Stepping

Purpose: power, hip turnover, caloric expenditure
Distance: single step; two to three flights
Load: body weight, weight vest (<10% body weight)
Speed: variable (distance dependent)

The use of the stairs presents numerous activities for sports performance as well. In addition to what has already been discussed above, Quick Feet (rapid alternating position switch), Double Leg Upward Bounds (double leg jumps), Laterals or Crossovers (frontal plane stepping) all are effective activities for speed or metabolic work. Depending on the goal and once skill acquisition is attained these activities along with step running can be loaded with added benefit. Early studies looked at the added effect of loading as it relates to power output. One study published in the *European Journal of Applied Physiology* examined the effect of variable external loads on power output measured by running upstairs. Fourteen male subjects (16-31 years of age) who regularly participated in competitive sports performed maximal stair step tests under five experimental loading conditions (no external load, 10.1, 19.2, 24.2, and 29.2 kg). Investigators found significant increases in power output when external loads were used compared to body weight. The amount of resistance used is again specific to the goal; for speed work less than 10% of body weight is recommended. Heavier loads can be used when ballistic strength is desired over movement speed or power with technique and safety being the limiting factors to the weight selected.

When using stairs, the standard energy system specifics and fatigue-related safety factors determine the placement in the exercise order. Phosphagen driven exercises go first with power activities coming before those aimed at strength, and glycolytic driven activities or metabolic work can be done later in the exercise bout, based on purpose. Stair work though does come with a risk, so siding with caution and ensuring adequate energy and focus are present when performing activities on the stairs is important. Movement quality should always be a primary emphasis. When caloric expenditure is the goal, particularly in the obese population, use the activities early in the bout as they are fatiguing and for some individuals just body weight stair climbs present quite a difficult task. When fatigue leads to sloppy movement patterns increase the rest or discontinue the activity to decrease injury risk.

Featured Stair Exercises

MB Overhead Stepping

Start

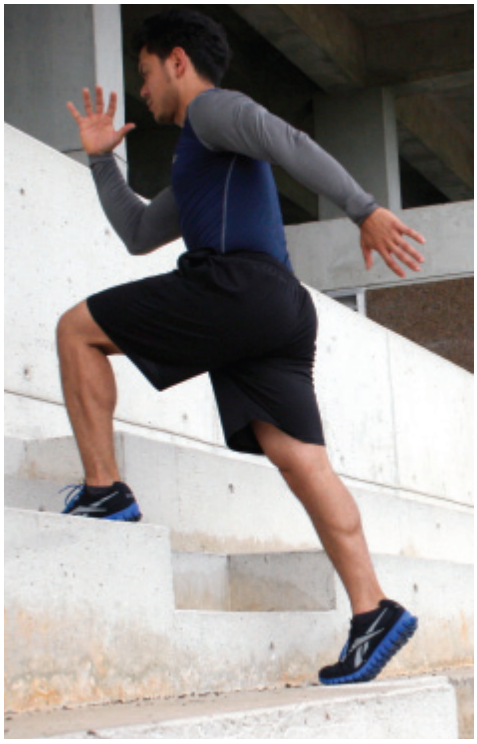
Mid

End

Stair Bounding

Start

Mid



End

DB Stepping


Start


Mid 1


Mid 2


End

Speed Stepping


Start


Mid 1


Mid 2


End