SELECTED CLINICAL RESEARCH SUMMARY

ALTER G®

How Does it Work?

The AlterG® Anti-Gravity Treadmill™ features patented, NASA-inspired Differential Air Pressure (DAP) technology to precisely and consistently unweight the user in 1% increments of the user's actual body weight throughout the range of activities performed within each session.

AlterG enables patients and athletes to move – unrestricted and pain free – restoring and building muscle strength, range of motion, balance, function, and fitness. No other unweighting technology offers as much precision, accuracy and comfort.

Efficacy Backed by Science

Every AlterG Anti-Gravity system is designed based on the culmination of empirical evidence, substantial foundational studies, and case studies; giving you confidence in its effectiveness compared to traditional rehabilitation methods alone. The following summary highlights a selection of peer-reviewed research featuring AlterG Anti-Gravity treadmill, showcasing applications across various categories.

	Basic Science: Ground reaction forces are reduced, with similar aerobic demands. Progressive joint loading at the knee can be achieved through a combination of body weight support and treadmill speed. EMG activity shows muscle firing patterns and gait mechanics are maintained, for all levels of weight support and speed [1-3, 19]
	Neurologic: Improved gait kinematics, improved dynamic balance, increased walking speeds and distances, and functional gait improvements following anti-gravity treadmill training have been studied in a variety of disease states including Parkinson's disease, cerebral palsy, and cerebrovascular accidents.[4-11]
	Orthopedic: Progressive loading protocols enable modulation of joint loading forces during closed chain kinetic exercises following orthopedic injury, resulting in decreased pain to lower extremities, improved joint function, increased muscle strength, and reduced muscle atrophy. [12-15]
	Weight Loss: Use of AlterG to simulate a reduced BMI has been demonstrated to enable overweight patients to exercise and walk pain-free at a distance, intensity level, and speed that they would not be able to achieve on their own.[16-17]
	Cardiac: Cardiorespiratory load is reduced proportionally to the lower metabolic demand resulting from the body weight support during exercise .[18]
	Running/Performance Training: Body weight support reduced metabolic demand, effective for overspeed or HIIT training, and) allows for attenuation of the biomechanical risks of running so that movements can safely be repeated and improved, potentially allowing athletes to increase training volume or return to running sooner following injury or surgery".[19-23]
	Geriatric: Improvements in knee pain, joint function, and thigh muscle strength are seen with walking under lower body positive pressure, in addition to demonstrated lower heart rate, systolic blood pressure, and oxygen consumption. [24-26]

Basic Science

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1. Metabolic and Biomechanical Effects of Velocity and Weight Support Using a Lower Body Positive Pressure Device During Walking. Grabowski, A.: Archives of Physical Medicine and Rehabilitation, 91:951-957, 2010.

Proof of basic principles during walking is important for post injury, post-operative, and other groups who would not be expected to run on an anti-gravity treadmill. Combinations of velocity and body-weight support resulted in similar aerobic demands, yet faster walking and lowered peak Ground Reaction Forces (GRFs) with body-weight support compared to normal weight walking.

2. Antigravity Treadmills Are Effective In Reducing Knee Forces. Patil, S., Steklov, N., Bugbee, W.D., Goldberg, T., Colwell Jr., C.W., D'Lima, D.: Journal of Orthopedic Research. 2012 Dec 13.

Jogging at 4.5 mph with 50% body weight support provides similar vertical knee joint reaction forces as walking at 2.5-3.5 mph full body weight The strong correlation between tibiofemoral force and walking speed and unweighting allows for more precisely achieving the target knee forces desired during early rehabilitation.

3. Utilization of the Anti-Gravity Treadmill in a Physical Activity Program with Female Breast Cancer Survivors: A Pilot Study. Fairman, C.M., Kendall, K.L., Harris, B.S., Crandall, K.J., McMillan, J.: International Journal of Exercise Science. 2016: 9(1): 101-109.

Improvements in cardiovascular endurance and body composition were observed. AlterG may provide meaningful improvements in physiological and psychological variables.

Neurologic

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4. Effect of Antigravity Treadmill Gait Training on Gait Function and Fall Risk in Stroke Patients. Oh, K. et al. *Ann Rehabil Med 2022;46(3):114-121*

This study showed that Anti-Gravity Treadmill Training (AGT) enhances dynamic balance and gait speed and effectively lowers fall risk in stroke patients. Therefore, AGT can be a beneficial alternative therapy to conventional gait therapy for improving gait function and balance in stroke patients.

5. Walking on the Moon: A randomized clinical trial on the role of lower body positive pressure treadmill training in post-stroke gait impairment. Calabrò, Rocco Salvatore et al. *Journal of advanced research* vol. 21 15-24. 19 Sep. 2019

Lower body positive pressure treadmill training with AlterG resulted in walking faster, large changes in the temporal walking kinematics, an improvement in functional ambulation, and a better muscle activation pattern, with particular regard to antigravity muscles as compared to treadmill gait training. These data suggest that lower body positive pressure treadmill gait training specifically targets the gait features that are abnormal in chronic post-stroke patients.

6. Anti-Gravity Training Improves Walking Capacity and Postural Balance In Patients With Muscular Dystrophy. Berthelsen, M.P., Husu, E., Christensen, S.B., Prahm, K.P., Vissing, J., Jensen, B.R.: Neuromuscular Disorder, 2014.

The training volume (intensity, frequency and duration) applied in this study resulted in significant improvements in walking capacity and dynamic balance without apparent signs of muscle damage.

7. Aerobic Anti-Gravity Exercise in Patients with Charcot-Marie Tooth Disease Types 1A and X: A Pilot Study. Knak, K., Andersen, L.K., Vissing, J.: Brain and Behavior. November 2017 2; 7(12).

Patients with CMT performed moderate intensity aerobic exercise in the Anti-Gravity treadmill. Significant positive difference in Berg balance test and postural stability test. Walking distance in six minute walk increased.

8. Improved clinical status, quality of life, and walking capacity in Parkinson's disease after body weight-supported high-intensity locomotor training. Rose, Martin H et al. *Archives of physical medicine and rehabilitation* vol. 94,4 (2013): 687-92. doi:10.1016/j.apmr.2012.11.025

Body weight-supported progressive high-intensity locomotor training is feasible and well tolerated by patients with PD. The training improved clinical status, quality of life, and gait capacity significantly. Patients had a 10.6% increase in mean walking distance after 8 weeks of aerobic exercise on an anti-gravity treadmill.

9. Anti-Gravity Treadmill Training for Freezing of Gait in Parkinson's Disease. Baizabal-Carvallo, José Fidel et al. *Brain sciences* vol. 10,10 739. 15 Oct. 2020, doi:10.3390/brainsci10100739

Compared to baseline, patients showed improvement in the Freezing of Gait Questionnaire and a mean reduction of 7 s in the Timed Up & Go. Moderate or significant improvement in gait was reported by 84% of patients.

10. Effect of Lower Body Positive Pressure Aerobic Training on Fall Risk in Patients with Diabetic Polyneuropathy: Randomized Controlled Trial. Abdelaal, Ashraf A, and Shamekh M El-Shamy. European journal of physical and rehabilitation medicine vol. 58,1 (2022): 33-42.

Moderate intensity LBPP treadmill training program can effectively improve task-oriented gait, balance performance, and fall risk scores in patients with DPN. The 25% off-loading during the LBPP treadmill training program yielded the most favorable short and long-term improvements compared to the other weight off-loading percentages in patients with DPN.

11. The Effects of Lower Body Positive Pressure Treadmill Training on Dynamic Balance of Children with Cerebral Palsy. Dadashi, F., Kharazi, M. R., Lotfian, M., Shahroki, A., Mirbagheri, A., & Mirbagheri, M. M. *Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual International Conference*, *2018*, 2487–2490.

AlterG Anti-Gravity Treadmill Training was compared against traditional occupational therapy in four children with spastic Cerebral Palsy. Results showed improvements in maximum velocity and acceleration of the COP and COM for both AlterG training patients (15-90%), though there was a limited improvement of 0.2-24% in some features of the control patients.

Orthopedic

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12. Managing Knee Osteoarthritis: The Effects of Body Weight Supported Physical Activity on Joint Pain, Function, and Thigh Muscle Strength. Peeler, J., Christian, M., Cooper, J., Leiter, J., MacDonald, P.: Clinical Journal Sport Medicine 2015 Jan 30. Nov;25(6):518-23.

Participants required dramatically less LBP support to walk pain free on the treadmill over time. LBPP supported low load exercise regimen can be used to significantly diminish knee pain, enhance joint function, and increase thigh muscle strength, while safely promoting pain free walking exercise in overweight patients with knee OA.

13. Recent Advances in the Rehabilitation of Anterior Cruciate Ligament Injuries. Wilk, K.E., Macrina, L.C., Cain, L., Dugas, J.R., Andrews, J.R.: Journal of Orthopaedic and Sports Physical Therapy, 42(3):153-171, 2012.

A majority of individuals who sustain an ACL injury also have sustained a bone bruise to the lateral femoral condyle and lateral tibial plateau, which can result in an increase in postoperative swelling, pain, and muscle inhibition. Use of a progressive loading treadmill (e.g. AlterG) to initiate a walking or running program can minimize impact loading on the knee joint. This progression of applied and functional stresses is used to provide a healthy stimulus for healing tissues without causing damage.

14. Anti-Gravity treadmill rehabilitation improves gait and muscle atrophy in patients with surgically treated ankle and tibial plateau fractures after one year: A randomized clinical trial. Palke, Lisa et al. Clinical rehabilitation vol. 36,1 (2022): 87-98.

One year after surgery, patients who had undergone anti-gravity treadmill rehabilitation showed better gait than patients in the control group, and those with tibial plateau fractures had less muscle atrophy.

15. Exploring the effects of anti-gravity treadmill training in musculoskeletal disorders: A systematic Review. Trovato, Bruno et al. *Heliyon* vol. 10,23 e40605. 22 Nov. 2024

Despite differences in protocols, interventions consistently demonstrated safety, feasibility, and low dropout rates. Clinically relevant improvements were detected in ROM, gait functionality, and pain reduction in individuals with ankle, hip, and femoral fractures, total knee arthroplasty, Achilles tendon repair, and postoperative ACL reconstruction.

Weight Loss

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16. Simulated weight reduction using an anti-gravity treadmill – a pilot study of the impact of weight loss on foot and ankle arthritis. Morley, W. J., Dawe, E., Boyd, R., Creasy, J., Grice, J., Marsland, D., Taylor, H., & Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust UK (2021). *Foot and ankle surgery: official journal of the European Society of Foot and Ankle Surgeons*, *27*(7), 809–812.

Using an anti-gravity treadmill to reduce the effective force of gravity to simulate the forces at a normal BMI caused significant reductions in pain during exercise for obese patients with foot and ankle arthritis.

17. Using the Alter-G Treadmill System with an Extremely Obese Female: A Case Study. Simonson, S.R., Shimon, J.M., Long, E.M. and Lester, B.E., 2011. *Clinical Kinesiology (Online Edition)*.

A 14-week walking program was conducted with the AlterG treadmill for an obese female. Overall, the AlterG Treadmill enabled the participant to exercise and walk pain-free at a distance, intensity level, and speed that she could not accomplish while walking on her own, resulting in increased exercise tolerance, weight reduction, decrease in upper body circumference, and reduced lower extremity swelling, in addition to a 9.7% decrease in fasting blood glucose.

Cardiac

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18. The Effect of Lower Body Positive Pressure on the Cardiorespiratory Response at Rest and during Submaximal Running Exercise. Stucky, Frédéric et al. *Frontiers in physiology* vol. 9 34. 30 Jan. 2018

At a given Lower Body Positive Pressure, once reaching steady-state exercise, the cardiorespiratory load is reduced proportionally to the lower metabolic demand resulting from the body weight support during exercise. The balance between cardiovascular response, oxygen delivery to the exercising muscles, and blood pressure regulation is maintained at exercise steady-state.

Running/Performance Training

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19. Determination of Muscle Activity During Running at Reduced Body Weight. Liebenberg, J., Scharf, J., Forrest, D., Dufek, J.S., Masumoto, K., Mercer, J.A.: Journal of Sports Sciences 29(2): 207- 214, 2011.

Reducing body weight leads to a reduction in muscle activity with no changes in muscle activity patterns. Ground reaction forces and running mechanics are maintained with weight support. Training with body weight support may provide benefits of decreasing overuse injury for runners.

20. The Effect of Lower Body Positive Pressure on Muscle Activation During Running. Jensen, Bente Rona; Hovgaard-Hansen, Line; Cappelen, Katrine Louise. Proceedings of the XXII Congress of the International Society of Biomechanics, July 5-9, 2009, Cape Town, South Africa. International Society of Biomechanics, 2009. p. 143.

Running with reduced body weight in a lower body positive pressure treadmill chamber allows running with near-normal movement pattern.

21. Maximal Physiologic Parameters During Partial Body-Weight Support Treadmill Testing. Gojanovic, B., Cutti, P., Shultz, R., Matheson, G.O.: Medicine and Science in Sports and Exercise, 2012 Apr 24.

The AG can be used at maximal exercise intensities at BW of 85% to 95%, reaching faster running speeds than normally feasible. The AG could be used for overspeed running programs at the highest metabolic response levels.

22. Overspeed HIIT in Lower Body Positive Pressure Treadmill Improves Running Performance. Gojanovic, B., Shultz, R., Feihl, F., Matheson, G.: Medicine and Science in Sports and Exercise (2015)

The four-week HIIT protocol improved field performance, VO2 Max, and submaximal heart rate. Authors state that LBPP could provide an alternative for taxing HIIT sessions.

23. Physiological and Biomechanical Responses of Highly Trained Distance Runners to Lower-Body Positive Pressure Treadmill Running. Barnes, K.R., Janecke, J.N.: Sports Medicine Open (2017). 3(1): 41.

Increasing BWS increased stride length and flight duration and decreased stride rate and contact time. Biomechanical changes during LBPPT running all contributed to less metabolic cost and corresponding physiological changes. The results also indicate the male and female distance runners have similar physiological and biomechanical responses to LBPPT running.

Geriatric

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24. Anti-Gravity Treadmill Can Promote Aerobic Exercise For Lower Limb Osteoarthritis Patients. Kawae,T., Mikami, Y., Fukuhara, K., Kimura, H., Adachi N.: Journal of Physical Therapy Science 29:1444-1448, August 2017.

Anti-gravity treadmill allows for lower extremity load to be adjusted, which is useful for those with lower limb OA. Pain after walking was significantly greater with walking on level ground versus in the Anti-gravity treadmill. Subjects were able to tolerate faster walking speeds in the Anti-gravity treadmill versus level ground walking.

25. Effect of Body Weight-Supported Exercise on Symptoms of Knee Osteoarthritis: A Follow-up Investigation. Peeler, J, Leiter, J., MacDonald, P.: Clinical Journal of Sports Medicine, 2018, 30. 1. 10.1097

Data show improvements in knee pain, joint function, and thigh muscle strength associated with participation in a 12-week Lower Body Positive Pressure supported low-load exercise regime were maintained well after cessation of the program.

26. Cardiovascular Responses in Older Adults With Total Knee Arthroplasty at Rest and With Exercise on a Positive Pressure Treadmill. Webber, S., Horvey, K., Yurach, M., Butcher, S.: European Journal of Applied Physiology 2014 114:653-662.

Older adults with TKA demonstrated lower heart rate, systolic blood pressure, oxygen consumption and minute ventilation levels when walking under lower body positive pressure conditions. The Anti-Gravity Treadmill exercise enabled TKA patients to walk at a faster speed and/or to tolerate greater incline that may be important in rehab of these patients.