UNIVERSITÄTSKLINIKUM jena

Endogene Schmerzhemmung durch körperliche Aktivität

Hans-Georg Schaible
Institut für Physiologie 1
Neurophysiologie
Universitätsklinikum Jena

UNIVERSITÄTSKLINIKUM jena

Marie Hoeger Bement. Excercise-induced Hypoalgesia. An Evidence-based Review
In: Mechanisms and Management of Pain for the Physical Therapist,
edited by K.A. Sluka. 2009, pp. 143-166

Mechanisms of Exercise-induced Hypoalgesia

Opioid mechanisms

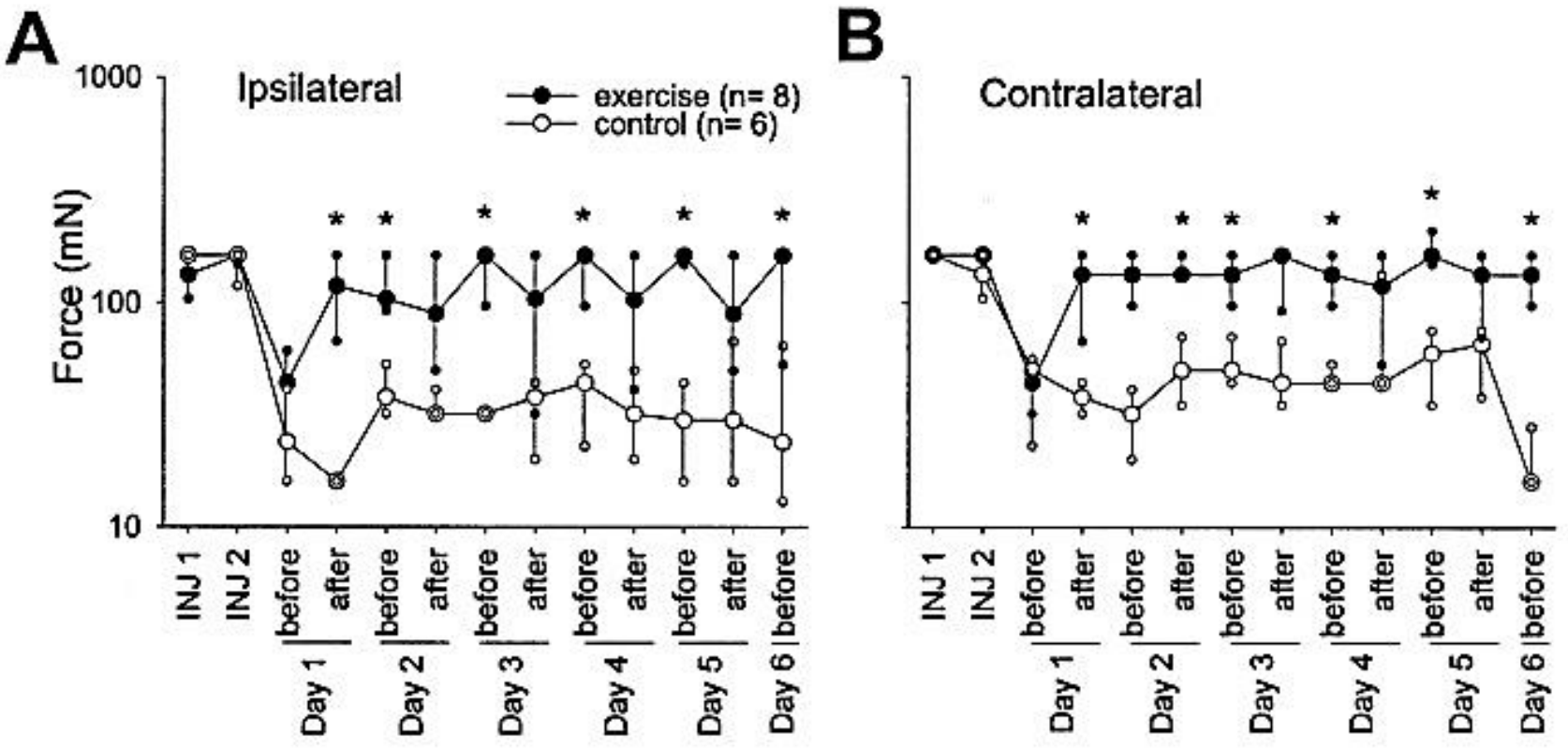
Peripheral mechanisms: enhanced levels of ß-endorphin in the plasma;
ß-endorphin is released by the pituitary

Central mechanisms: Release of ß-endorphin via the hypothalamus which has projections to the periaqueductal grey and activates descending inhibitory pathways

Non-opioid mechanisms

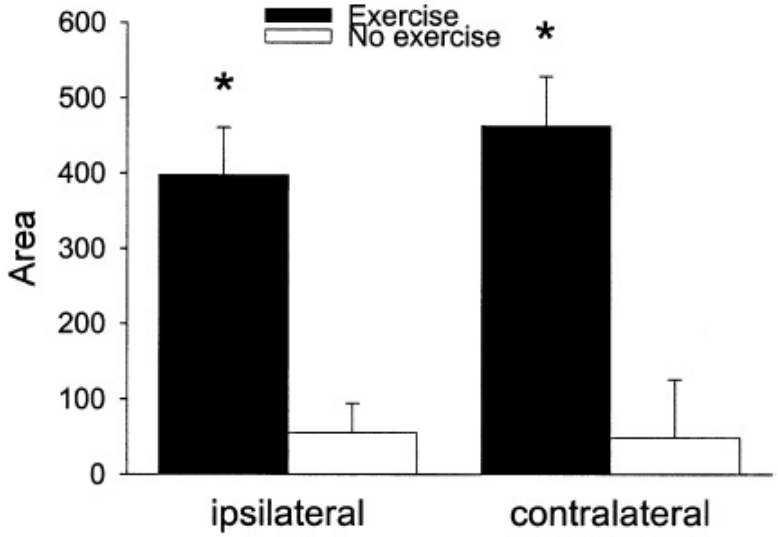
- Exercise may decrease disease activity
- Exercise may improve body mechanics
- Exercise may improve the affective-motivational component of pain (runner´s high)
- Exercise may improve social components
- Gate-control theory: myelinated afferents may inhibit nociceptive processing
- Activation of the corticospinal tract which may induce presynaptic inhibition
- Exercise may induce stress and evoke stress-induced analgesia
- Enhancement of blood pressure may reduce pain (baroreceptor activity inhibits pain)

Holger Bement MK, Sluka KA. Low intensity exercise reverses chronic muscle pain in the rat in a naloxone-dependent manner. Arch Phys Med Rehabil 2005;86:1736-40

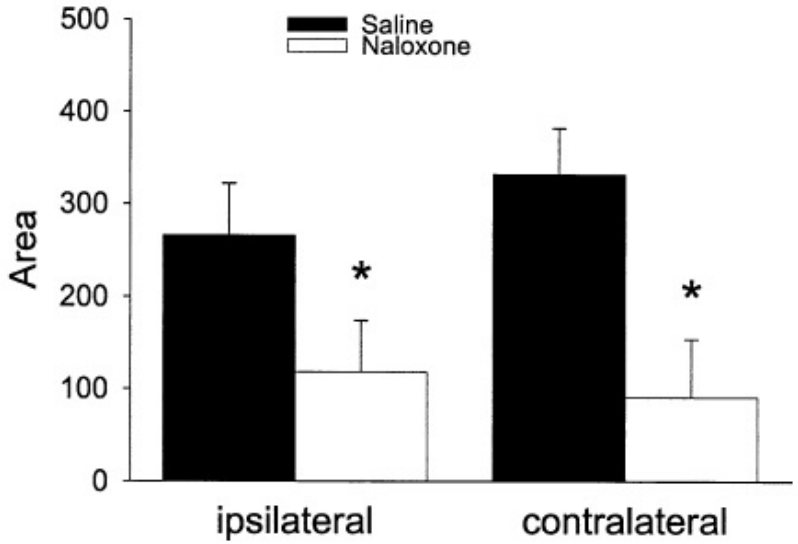


Muscle pain was induced by two injections of acidic saline solution, pH 4.0, into the left gastrocnemius muscle; exercise: walking on a treadmill (15 or 30 min)

Holger Bement MK, Sluka KA. Low intensity exercise reverses chronic muscle pain in the rat in a naloxone-dependent manner. Arch Phys Med Rehabil 2005;86:1736-40



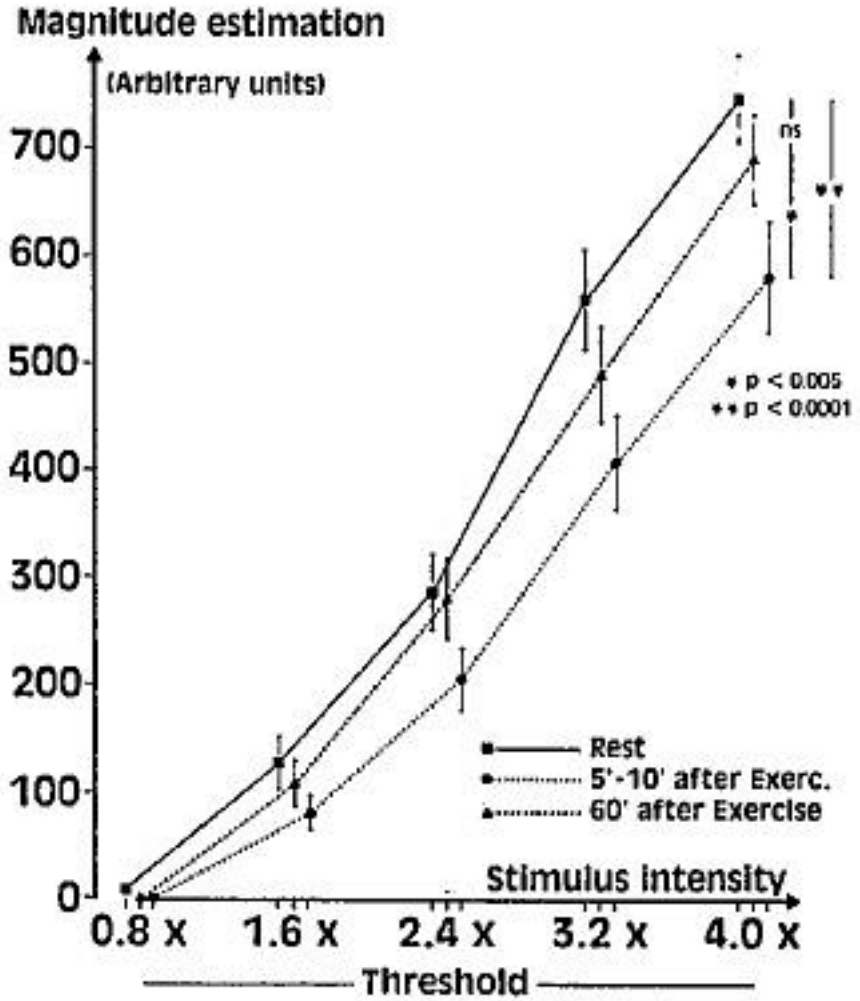
Reversal of mechanical hyperalgesia by exercise



Daily naloxone before exercise attenuated the antihyperalgesic effect of exercise

UNIVERSITÄTSKLINIKUM jena

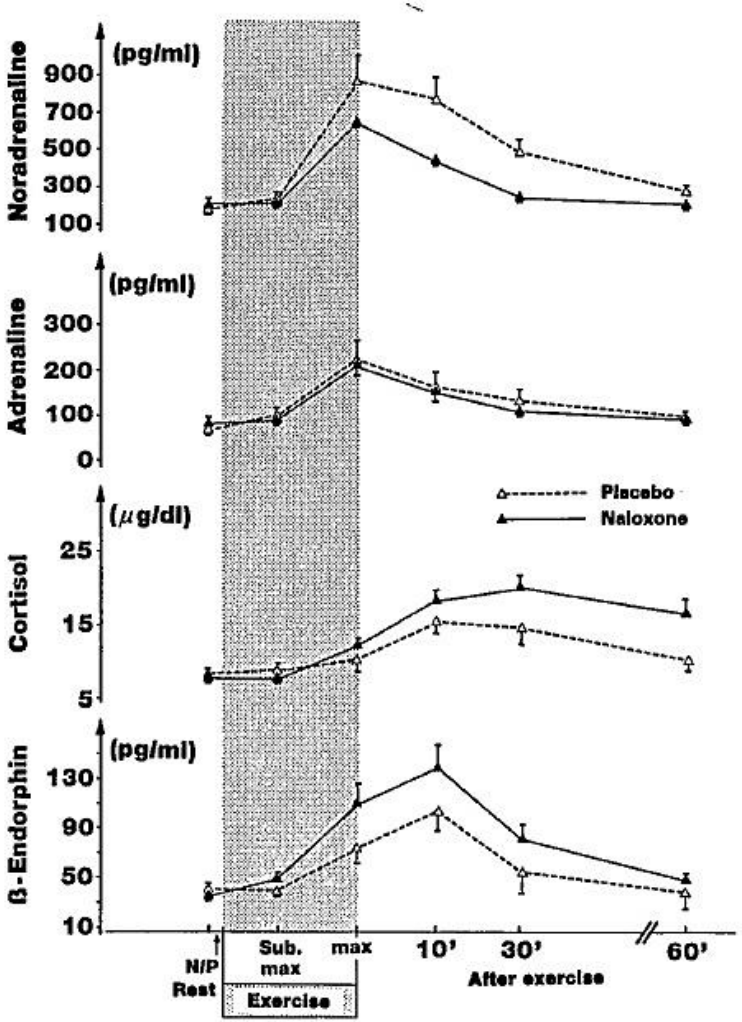
Droste C, Greenlee MW, Schreck M, Rohkamm H. Experimental pain thresholds and plasma beta-endorphin levels during exercise. Med Sci Sports Exerc 1991;23:334-42



Healthy subjects:
Estimation of pain intensity (electrical stimulation of tooth and finger) at rest, 5-10 min after exercise, and 60 min after exercise

Exercise: cycle ergometer, stepwise increase by 50 Watt every 3 min, starting at 100 W

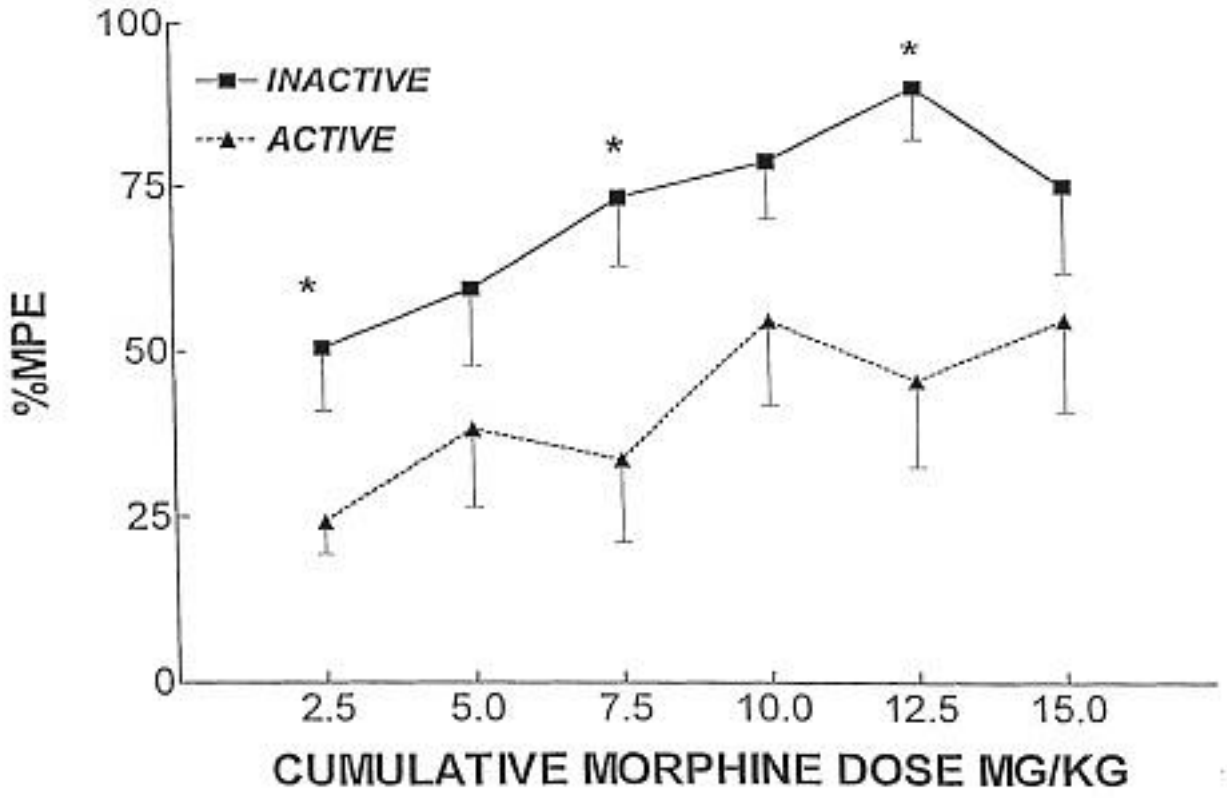
Droste C, Greenlee MW, Schreck M, Rohkamm H. Experimental pain thresholds and plasma beta-endorphin levels during exercise. Med Sci Sports Exerc 1991;23:334-42



Time course of blood endocrine levels in the plasma following naloxone or placebo injections

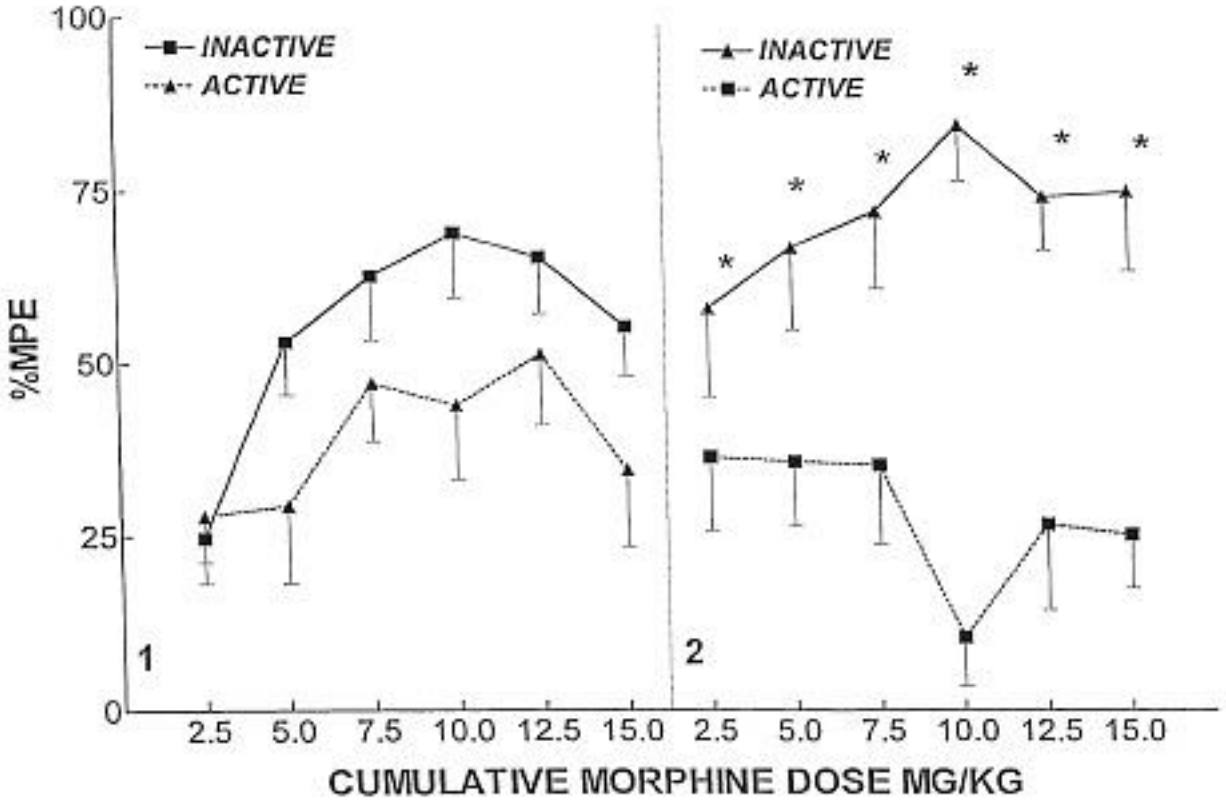
Changes in pain threshold and changes in beta-endorphin levels were not significantly correlated with each other!!

Kanarek RB, Gerstein AV, Wildman RP, Foulds Mathes W, D´Anci KE. Chronic running-wheel activity decreases senstivity to morphine-induced analgesia in male and female rats. Pharmacy Biochem Behav 1998; 61:19-27



Maximal possible effect of morphine, heat tail-flick test; Activity rats ran in activity wheels for 20 days prior to nociceptive testing

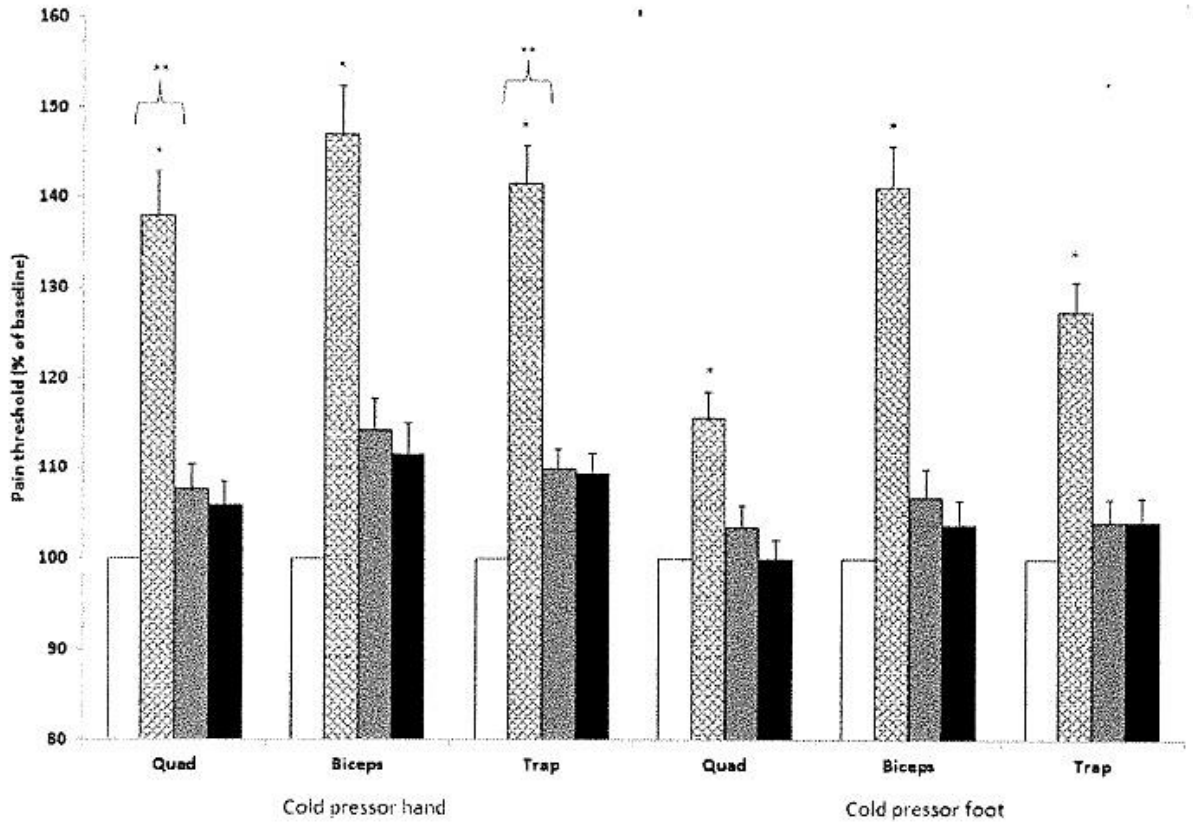
Kanarek RB, Gerstein AV, Wildman RP, Foulds Mathes W, D´Anci KE. Chronic running-wheel activity decreases senstivity to morphine-induced analgesia in male and female rats. Pharmacy Biochem Behav 1998; 61:19-27



1: rats ran in activity wheels for 17 days prior to testing

2: Reversal of activity conditions

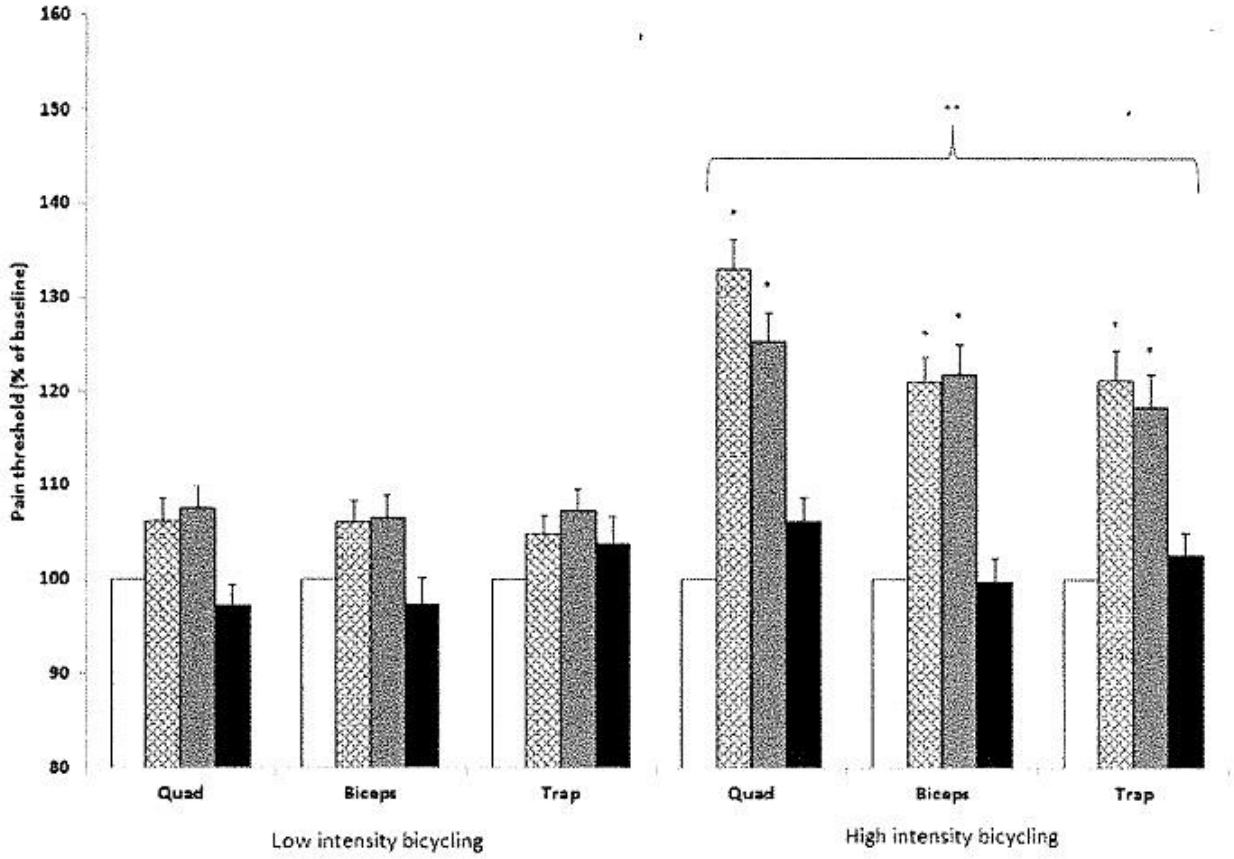
Vaegter HB, Handberg G, Graven-Nielsen T. Similarities between exercise-induced hypoalgesia and conditioned pain modulation in humans. Pain 2013;155:158-176



Pressure pain threshold at three assessment sites before, during cold pressure test, immediately after cold pressure test and 15 min after cold pressure test.

UNIVERSITÄTSKLINIKUM jena

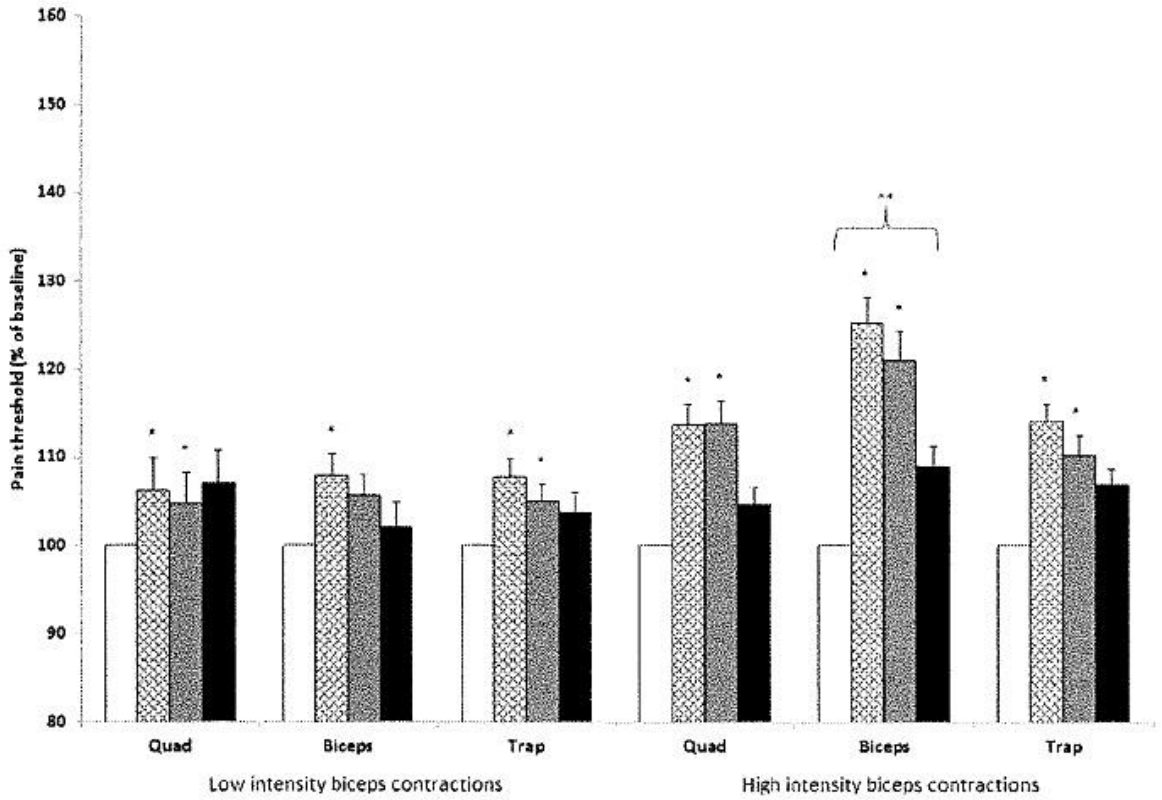
Vaegter HB, Handberg G, Graven-Nielsen T. Similarities between exercise-induced hypoalgesia and conditioned pain modulation in humans. Pain 2013;155:158-176



Pressure pain threshold at three assessment sites before, after 10 min bicycling, after 2 x 10 min bicycling, and 15 min after bicycling.

UNIVERSITÄTSKLINIKUM jena

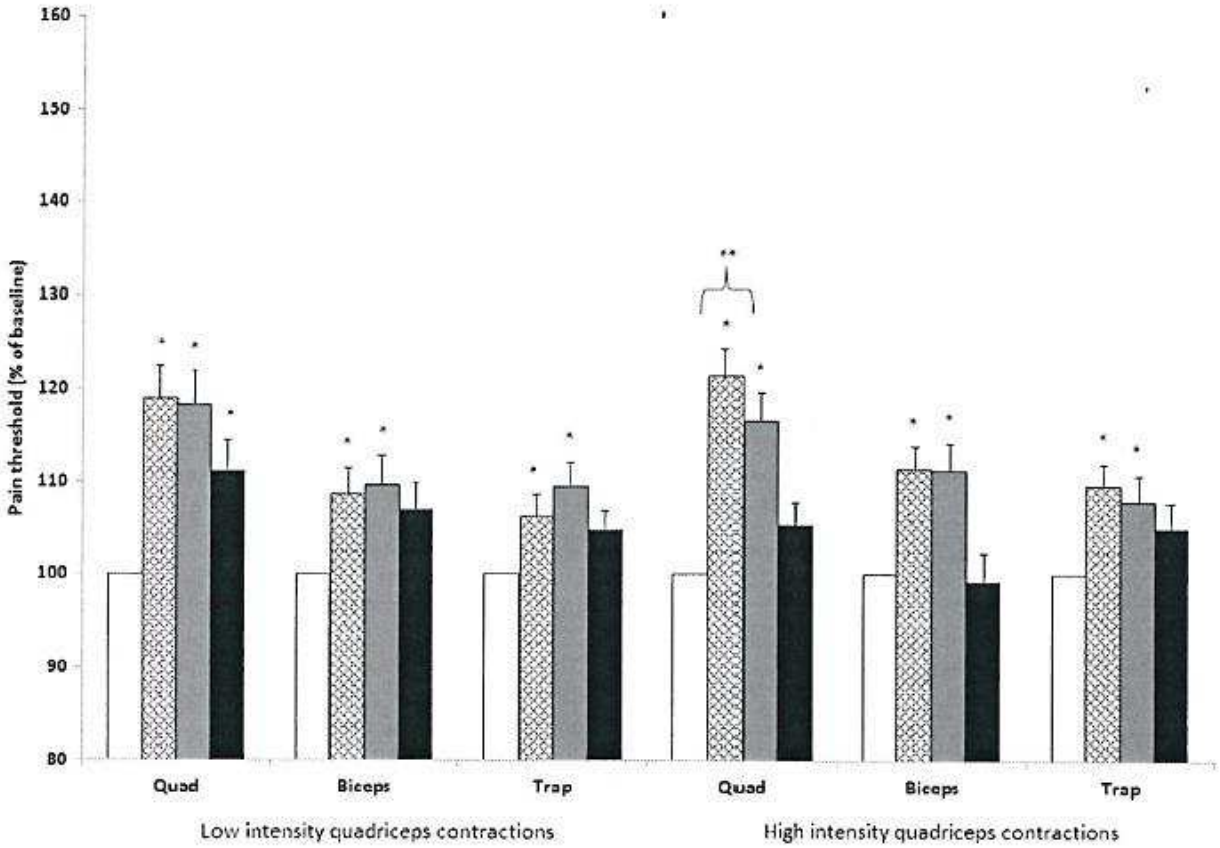
Vaegter HB, Handberg G, Graven-Nielsen T. Similarities between exercise-induced hypoalgesia and conditioned pain modulation in humans. Pain 2013;155:158-176



Pressure pain threshold at three assessment sites before, after first biceps contraction, after second biceps contraction, and 15 min after biceps contraction.

UNIVERSITÄTSKLINIKUM jena

Vaegter HB, Handberg G, Graven-Nielsen T. Similarities between exercise-induced hypoalgesia and conditioned pain modulation in humans. Pain 2013;155:158-176



Pressure pain threshold at three assessment sites before, after first quadriceps contraction, after second quadriceps contraction, and 15 min after quadriceps contraction.

UNIVERSITÄTSKLINIKUM jena

Vaegter HB, Handberg G, Graven-Nielsen T. Similarities between exercise-induced hypoalgesia and conditioned pain modulation in humans. Pain 2013;155:158-176

Conclusions:

Acute exercise evokes **multisegmental decrease** in pain sensitivity during and following exercise in healthy subjects. EIH larger in exercising body part.

Aerobic exercise produces hypoalgesic effect at moderate to high intensity for longer periods.

Isometric exercise produces EIH at low and high intensity, duration less important.

UNIVERSITÄTSKLINIKUM jena

Marie Hoeger Bement. Excercise-induced Hypoalgesia. An Evidence-based Review
In: Mechanisms and Management of Pain for the Physical Therapist,
edited by K.A. Sluka. 2009, pp. 143-166

Mechanisms of Exercise-induced Hypoalgesia

Opioid mechanisms

Peripheral mechanisms: enhanced levels of ß-endorphin in the plasma;
ß-endorphin is released by the pituitary

Central mechanisms: Release of ß-endorphin via the hypothalamus which has projections to the periaqueductal grey and activates descending inhibitory pathways

Non-opioid mechanisms

- Exercise may decrease disease activity
- Exercise may improve body mechanics
- Exercise may improve the affective-motivational component of pain (runner´s high)
- Exercise may improve social components
- Gate-control theory: myelinated afferents may inhibit nociceptive processing
- Activation of the corticospinal tract which may induce presynaptic inhibition
- Exercise may induce stress and evoke stress-induced analgesia
- Enhancement of blood pressure may reduce pain (baroreceptor activity inhibits pain)