

Sports Compression Garments: Application Guide

Mr Daniel Chi-Wo LEE

May 21, 2019 (Tuesday), 1930-2130, HKSI

Sports Compression Garment (CG)??



<https://www.fancydress-factory.co.uk/>



<https://www.amazon.com/Xcoser-Mystique-Costume-Halloween-Cosplay/dp/B01G0842KA>



Definition of CG

- A piece of garment that **applies mechanical pressure** to the body surface hence compressing and stabilizing the underlying tissues;
- Available in various designs :
 - Lower-body from the ankle up to the waist;
 - Upper-body and;
 - Cover the limbs, fully or partially e.g. sleeves and stockings.

(MacRae et al., 2011)



<https://www.2xu.com.hk/>



Sports Compression Garment (CG)

- Popular among competitive and recreational athletes;
- Compression Wear and Shapewear Market is expected to reach US\$5,576 million by 2022;

Allied Market Research, 2016

(<https://www.alliedmarketresearch.com/compression-wear-shapewear-market>)



<https://www.runtothefinish.com/running-in-compression-pants/>



<https://www.chinadailyhk.com/articles/161/184/184/1550388375573.html>



History of CG application

- Clinical Application:

| Clinical conditions | Suggested benefits |
|--|--|
| <ul style="list-style-type: none">• Deep vein thrombosis• Chronic-venous insufficiency• Wound recovery | <p>Cross-sectional area of the vein</p> <p>Blood pooling at limbs</p> <p>Venous blood flow</p> |

(Agu et al., 1999; O'Meara et al., 2012; Partsch, 2014)



Burn scar management



Treatment of Deep vein thrombosis patient

(<https://www.healthpartners.com/hospitals/regions/specialties/burn-center/scar-management/>)



Clinical application of CG

Venous Disease A-Z series: no. 7

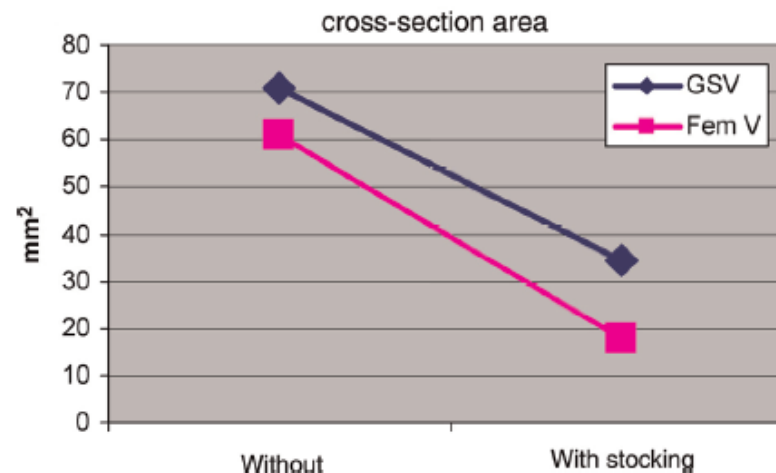
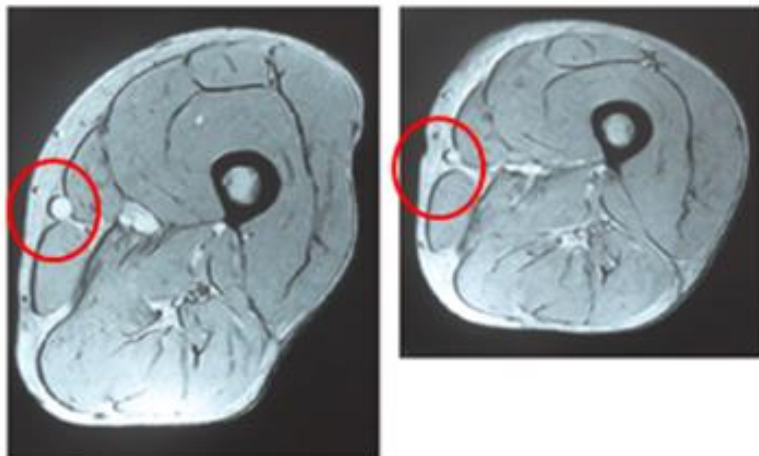
Thigh compression

H Partsch* and G Mosti†

*Private Practice, Vienna, Austria; †Department of Angiology and Cardiology, Casa di cura Barbantini, Lucca, Italy

Phlebology 2008;23:252–258. DOI: 10.1258/phleb.2008.008053

Figure 1 (a) Magnetic resonance image cross-section at mid-thigh level in a patient with massive varicose veins and a dilated great saphenous vein (GSV) in supine position. (b) A thromboprophylactic stocking exerting a pressure of 6 mmHg on the thigh leads to a reduction of the cross-section of the GSV and of the femoral vein. This low pressure is enough to make the contour of the thigh look more circular. (c) Planimetry shows a reduction of the cross-section area of both GSV and femoral vein with the stocking



Clinical application of CG

C. Jeanneret et al.: Compression stockings and calf veins
DOI 10.1024/0301-1526/a000362

Vasa 2014; 43: 268–277
© 2014 Hans Huber Publishers, Hogrefe AG, Bern

268 Original communication

Impact of compression stockings on calf-vein diameters and on quality of life parameters in subjects with painful legs

Christina Jeanneret¹, Konstantinos Karatolios¹, and Irene von Planta²

¹Kantonspital Baselland, Department of Angiology, University Clinic of Internal Medicine, Bruderholz, Switzerland

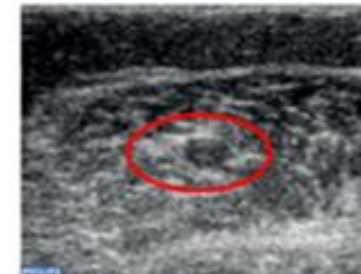
²Vascular Laboratory, St. Johann, Switzerland

not correlate with quality of life scores.

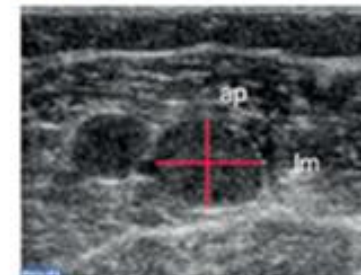
Conclusions: Intra - individually tested the calf muscle vein diameters decrease under compression, more pronounced in the prone than in the standing position. In the ankle area the PTV does not decrease in standing subjects. Quality of life assessed increases for both compression stockings.

No compression

Compression



Prone



Standing

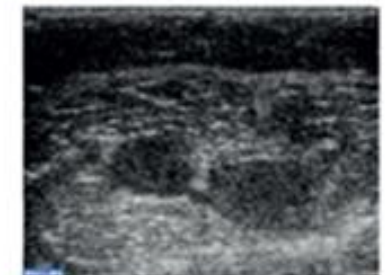


Figure 2: Duplexsonography imaging of gastrocnemius veins in standing and prone position, with and without compression, indication of measurement

ap = antero-posterior, lm = latero-medial



Clinical application of CG

European Journal of Vascular and Endovascular Surgery 44 (2012) 332–336



Contents lists available at [SciVerse ScienceDirect](#)

European Journal of Vascular and Endovascular Surgery

journal homepage: www.ejves.com



High Compression Pressure over the Calf is More Effective than Graduated Compression in Enhancing Venous Pump Function

G. Mosti^{a,*}, H. Partsch^b

WHAT THIS PAPER ADDS

- This study emphasises the importance of high compression pressure over the calf to enhance venous pumping function in patients with severe venous insufficiency, independently from the pressure profile. In our study, this high pressure was applied by wrapping inelastic material with a 'negative gradient': the compression pressure was stronger over the calf compared to the ankle. This concept is in disagreement with the usual belief that compression should always have a reducing graduated pressure profile from ankle to calf. In the future clinical practice, this means that we do not need to follow dogmatic rules to distribute the pressure of the bandage along the leg but should be guided by the wish to obtain optimal efficacy.



Any benefits of wearing CG in healthy individuals?!



Current findings on CG in sports



Claimed benefits of CG in sports



ORIGINAL RESEARCH
published: 26 October 2017
doi: 10.3389/fphys.2017.00834



Wearing Compression Tights on the Thigh during Prolonged Running Attenuated Exercise-Induced Increase in Muscle Damage Marker in Blood

Sahiro Mizuno¹, Mari Arai², Fumihiko Todoko², Eri Yamada² and Kazushige Goto^{1,3*}

Citation:

Mizuno S, Arai M, Todoko F, Yamada E and Goto K (2017) Wearing Compression Tights on the Thigh during Prolonged Running Attenuated Exercise-Induced Increase in Muscle Damage Marker in Blood. *Front. Physiol.* 8:834. doi: 10.3389/fphys.2017.00834

$\pm 3,370$ pg/mL 180 min, $P = 0.03$).

Conclusion: Wearing compression garment on the thigh significantly attenuated the increase in serum Mb concentration after exercise, suggesting that exercise-induced muscle damage was attenuated.

Keywords: compression gear, prolonged running, exercise-induced muscle damage, jump performance, maximal muscular strength

- 30 male participants RCT into different group
- Compression tights (15 mmHg)
- Stockings (15 mmHg)
- CON (<5 mmHg at calf and thigh)
- 120 mins running uphill @55% $\text{VO}_{2\text{max}}$
- 60 and 180 mins after run (Mb: Myoglobin)
- Rest with normal garment



Claimed benefits of CG in sports



RESEARCH ARTICLE

Wearing lower-body compression garment with medium pressure impaired exercise-induced performance decrement during prolonged running

Sahiro Mizuno¹, Mari Arai²✉, Fumihiko Todoko²✉, Eri Yamada²✉, Kazushige Goto³*

- 8 male participants
- *High tights* (thigh: 26.8 mmHg, calf: 29.2 mmHg)
- *Med tights* (thigh: 16.1 mmHg, calf: 17.9 mmHg)
- *Low tights* (thigh: 4.4 mmHg, calf: 3.0 mmHg)
- 120 mins running uphill @60% $\text{VO}_{2\text{max}}$
- Jump performance after run

PLOS ONE | <https://doi.org/10.1371/journal.pone.0178620> May 31, 2017

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Effects of wearing compression garment during prolonged running on exercise-induced fatigue

decision to publish, or preparation of the manuscript.

Competing interests: Three authors (Arai M, Todoko F, Yamada E) are affiliated to DESCENTE Ltd, which made garments for the present experiment. Although they contributed to conducting the present experiment (e.g., preparing custom-made garments, evaluating pressure levels), they were not involved in manuscript writing, discussion or drawing conclusion from

Conclusion

Wearing a lower body CG exerting medium pressure (approximately 15 mmHg) significantly attenuated decrease in jump performance than that with wearing a lower body CG exerting high pressure (approximately 30 mmHg). Furthermore, exercise-induced increases in HR and the inflammatory response were significantly smaller with CG exerted 15mmHg than that with garment exerted < 5 mmHg.



Claimed benefits of CG in sports

J Neurophysiol 120: 186–195, 2018.
First published April 11, 2018; doi:10.1152/jn.00581.2017.

RESEARCH ARTICLE | *Control of Coordinated Movements*

Effects of a compression garment on sensory feedback transmission in the human upper limb

© Trevor S. Barss,^{1,2,3} Gregory E. P. Pearcey,^{1,2,3} Bridget Munro,⁴ Jennifer L. Bishop,⁴ and E. Paul Zehr^{1,2,3,5}

- 13 participants (M: 5)
- Neurologically intact participants
- Custom-made, non-medical-grade compression sleeve, silicone at the proximal and distal ends
- 10 and 20 mmHg across forearm and upper arm
- Afferent Transmission during a static Task and movement

compression apparel modulates spinal cord excitability across multiple sensory pathways and movement tasks. Interestingly, there was a significant improvement in reaching accuracy while wearing the compression sleeve. Taken together, the compression sleeve appears to increase precision and sensitivity around the joint where the sleeve is applied. Compression apparel may function as a “filter” of irrelevant mechanoreceptor information allowing for optimal task-related sensory information to enhance proprioception.

NEW & NOTEWORTHY Wearing a customized compression sleeve was shown to alter the excitability of multiple pathways within the central nervous system regardless of conditioning input or movement task and was accompanied by improved accuracy of reaching movements and determination of movement end point. Compression apparel may assist as a type of “filter function” of tonic and nonspecific mechanoreceptor information leading to increased precision and movement sensitivity around the joint where compression is applied.



Claimed benefits of CG in sports

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INFLUENCE OF A COMPRESSION GARMENT ON REPETITIVE POWER OUTPUT PRODUCTION BEFORE AND AFTER DIFFERENT TYPES OF MUSCLE FATIGUE

WILLIAM J. KRAEMER^{a,*}, JILL A. B.
NOEL D. DUNCAN^c, JEFF S. VOL
PAUL CANAVAN^a, JOHN JOHNS^d
and WAYNE J. SEB.

- 22 athletic participants (M: 12, F: 10)
- Power fatigue: 10*10 max. effort jumps
- Strength fatigue: 4*supine Cybex leg press @ 10 RM
- Endurance fatigue: 30 mins run @ 70% VO_{2max}
- 3*50 isokinetic knee flexion and extension
- Lower body CG: waist to just above knee (*without mmHg*)
- Test: 10 CMJ (arms at waist)

customized software used to determine jump power. Ten consecutive maximal counter movement jumps with arms held at waist level were performed. The compressive garment had no effect on the maximal power of the highest jump in either men or women. The compressive garment significantly enhanced mean power output in the jump test both before and after different fatigue tasks. The compressive garment enhanced joint position sense at the hip at 45° and 60° of flexion. A compression garment also significantly reduced the vertical velocity of muscle movement upon landing. These data indicate that compression shorts do not improve maximal jump power output. However, an enhanced mean power output during the repetitive maximal jump test was observed when wearing a compression garment. The performance improvement observed may be due to reduced muscle oscillation upon impact, psychological factors, and/or enhanced joint position sense.



Claimed benefits of CG in sports

EFFECT OF AN ANKLE COMPRESSION GARMENT ON FATIGUE AND PERFORMANCE

NEMANJA ŠAMBAHER, SAIED J. ABOODARDA, DUSTIN B. SILVEY, DUA
DAVID G. BEHM

Journal of Strength and Conditioning Research
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326 *the Journal of Strength and Conditioning Research*

- 15 healthy, active participants (M: 7)
- Ankle CG: below knee to over ankle
- WU: Bicycling 5 min at 10 rpm, 1kP and 20 calf raise & 30 hops
- Test: ankle half-relaxation time
- Continuous drop jump @ 50cm
- MVC force

heights), continuous drop jump (30 cm), time to fatigue (TTF), and blood lactate concentration were measured pre- and post-warm-up and postfatigue. Compared with control condition, ankle CG condition had significantly reduced half-relaxation times ($p = 0.043$) and higher skin temperatures at post-warm-up and post-fatigue protocol ($p < 0.001$, $\Delta 3.2$ and $\Delta 4\%$, respectively). Participants also exhibited significantly lower ground reaction forces (GRFs) for 50-cm drop jumps ($p = 0.044$, $\Delta 9.9\%$) with ankle CG at post-warm-up. There were no significant differences between conditions for muscle contractile properties, MVC force or EMG, jump height, take-off velocity, contact time, and jumping TTF. Independent of group, there was a threefold increase in blood lactate ($p < 0.01$) from pre-warm-up to post-fatigue and a significant decrease in MVC force ($p = 0.048$, $\Delta 8.1\%$) from post-warm-up to postfatigue. Results suggest that ankle CG increased and maintained skin temperature during recovery, decreased twitch half-relaxation times, and reduced GRF from a 50-cm drop height. However, ankle CG did not improve other performance measures, aid in recovery, or affect blood lactate clearance.



Claimed benefits of CG in sports

Journal of Orthopaedic & Sports Physical Therapy
2001;31(6):282-290

Influence of Compression Therapy on Symptoms Following Soft Tissue Injury from Maximal Eccentric Exercise

William J. Kraemer, PhD¹
Jill A. Bush, PhD²
Robbin B. Wickham, MSPT¹
Craig R. Denegar, PhD, PT²
Ana L. Gómez, MS¹
Lincoln A. Gotshalk, PhD²
Noel D. Duncan, PhD²
Jeff S. Volek, PhD, RD¹
Margot Putukian, MD²
Wayne J. Sebastianelli, MD²

- 20 healthy women (non-strength trained)
- Compression sleeves for 5 days
- Worn immediately after exercise
- Non-compression group
- Upper arm circumference
- Creatine Kinase (CK)
- Subjective soreness perception
- Test: 2*sets (50 arm curl), 60°/s

group (n = 10). Subjects were instructed to avoid pain-relieving modalities (eg, analgesic medications, ice) throughout the study. The experimental group wore a compressive sleeve garment for 5 days following eccentric exercise. Subjects performed 2 sets of 50 passive arm curls with the dominant arm on an isokinetic dynamometer with a maximal eccentric muscle action superimposed every fourth passive repetition. One repetition maximum elbow flexion, upper arm circumference, relaxed elbow angle, blood serum cortisol, creatine kinase, lactate dehydrogenase, and perception of soreness questionnaires were collected prior to the exercise bout and daily thereafter for 5 days.

Results: Creatine kinase was significantly elevated from the baseline value in both groups, although the experimental compression test group showed decreased magnitude of creatine kinase elevation following the eccentric exercise. Compression sleeve use prevented loss of elbow motion, decreased perceived soreness, reduced swelling, and promoted recovery of force production.

Conclusions: Results from this study underline the importance of compression in soft tissue injury management. *J Orthop Sports Phys Ther* 2001;31:282-290.



Claimed benefits of CG in sports

COMPRESSION STOCKINGS USED DURING TWO SOCCER MATCHES IMPROVE PERCEIVED MUSCLE SORENESS AND HIGH-INTENSITY PERFORMANCE

SAMUEL VALENCIA GIMENES,¹ MOACIR MAROCOLO,² LARISSA NEVES PAVIN,¹
LEANDRO MATEUS PAGOTO SPIGOLON,^{3,4} OCTÁVIO BARBOSA NETO,¹ BRUNO VICTOR CÔRREA DA
SILVA,⁵ ROB DUFFIELD,⁶ AND GUSTAVO RIBEIRO DA MOTA¹

Journal of Strength and Conditioning Research
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CS and control groups performed similar total distances covered and not differ ($p > 0.05$) between groups, CS increased distances (effect size [ES] = 0.9–1.32) in higher-speed zones ($>19 \text{ km} \cdot \text{h}^{-1}$ CS $\sim 550 \text{ m}$ vs. control $\sim 373 \text{ m}$) alongside an increased number of accelerations (-50.0 to $-3.0 \text{ m} \cdot \text{s}^{-2}$) than control (CS: 33.7 ± 11.2 vs. control: 23.8 ± 7.9 ; $p = 0.003$; ES = 1.04). Perceived recovery did not differ ($p > 0.05$) between groups for either match but was worse in the second match for both groups. Perceived muscle soreness increased in control after match 2 (from $3.1 \pm$

- 20 outfield players (5 km run time $\sim 19:29$)
- Compression stockings (20-30 mmHg)
- CON garment (regular socks)
- 2 matches with match loads
- Running distance of the matches
- Perceived muscle soreness

1.9 to $6.3 \pm 1.6 \text{ AU}$; $p < 0.0010$) but did not in CS (from 2.8 ± 1.4 to $4.1 \pm 1.9 \text{ AU}$; $p = 0.6275$; ES = 1.24 CS vs. control after match). Accordingly, CS use during 2 soccer matches with 72-hour recovery reduces perceived muscle soreness in the second match and increases higher-speed match running performance.



Claimed benefits of CG in sports

Effect of Pressure Intensity of Compression Short-Tight on Fatigue of Thigh Muscles

NAOKAZU MIYAMOTO¹ and YASUO KAWAKAMI²

0195-9131/14/4611-2168/0

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DOI: 10.1249/MSS.0000000000000330

- 11 healthy young male
- Compression tights (thigh: 8 mmHg /calf: 15 mmHg)
- CON (non-compression shorts)
- 4.5 min WU run @ 6, 8, 10 kph, then 30 min at 12 kph
- MRI T2 imaging at pre- & post-run

pressure intensity of elastic compression short-tights on the metabolic state of thigh muscles during submaximal running. **Methods:** Two groups of 11 male subjects performed treadmill running at 12 km·h⁻¹ in three conditions in each of experiment 1 (short-tights with a compression intensity at the thigh of 8 mm Hg (LOW) and 15 mm Hg (MID) and noncompression shorts as control (CON1)) and experiment 2 (short-tights with 20 mm Hg (MID-HIGH) and 25 mm Hg (HIGH) and CON2). Before and immediately after the running exercises, T2-weighted magnetic resonance images of the right thigh were obtained without testing garments. From the images, skeletal muscle proton transverse relaxation time (T2) of each muscle in the thigh was calculated. **Results:** T2 was significantly increased after the treadmill running in all conditions in the hamstring and adductor muscles. In experiment 1, after the running, T2 elevation was significantly smaller in MID than that in CON1 for the biceps femoris, semimembranosus, adductor longus, and adductor magnus muscles. In experiment 2, after the running, T2 elevation was significantly lower in MID-HIGH than that in CON2 and HIGH for the biceps femoris, semimembranosus, and adductor longus. **Conclusions:** The findings suggest that wearing compression short tights with a pressure intensity of 15–20 mm Hg at the thigh can reduce development of fatigue of exercising muscles during submaximal running exercise in healthy adult males. **Key Words:** MAGNETIC RESONANCE IMAGING, TRANSVERSE RELAXATION TIME, TREADMILL RUNNING, HAMSTRING, HIP ADDUCTORS, MALE ADULTS



Claimed benefits of CG in sports

ORIGINAL ARTICLE

Effectiveness of post-match recovery strategies in rugby players

N D Gill, C M Beaven, C Cook

Br J Sports Med 2006;40:260-263. doi: 10.1136/bjsm.2005.022483

Objectives: To examine the effectiveness of four interventions on the rate and magnitude of muscle damage recovery, as measured by creatine kinase (CK).

Methods: 23 elite male rugby players were monitored transdermally before, immediately after, 36 hours after, and 84 hours after competitive rugby matches. Players were randomly assigned to complete one of four post-match strategies: contrast water therapy (CWT), compression garment (GAR), low intensity active exercise (ACT), and passive recovery (PAS).

Results: Significant increases in CK activity in transdermal exudate were observed as a result of the rugby match ($p < 0.01$). The magnitude of recovery in the PAS intervention was significantly worse than in the ACT, CWT, and GAR interventions at the 36 and 84 hour time points ($p < 0.05$).

Conclusions: An enhanced rate and magnitude of recovery was observed in the ACT, CWT, and GAR treatment groups when compared with the PAS group. Low impact exercise immediately post-competition, wearing compression garments, or carrying out contrast water therapy enhanced CK clearance more than passive recovery in young male athletes.

- 23*elite male rugby player
- Competition rugby
- Lower-body compression garment (~12 hrs)
- Passive recovery (9 mins bench sitting, etc.)
- Active recovery (7 mins spinning)
- Contrast water therapy 3*(1 mins 8-10 °C + 2 mins 40-22 °C)
- CK transdermal (36, 84 hrs)



Claimed benefits of CG in sports



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Journal of Science and Medicine in Sport

journal homepage: www.elsevier.com/locate/jsams



Original research

Wearing compression socks during exercise aids subsequent performance[☆]

Ned Brophy-Williams^{a,b,c,*}, Matthew W. Driller^d, Cecilia M. Kitic^b, James W. Fell^b, Shona L. Halson^{a,b}

<https://doi.org/10.1016/j.jsams.2018.06.010>

1440-2440/© 2018 Sports Medicine Australia. Published by Elsevier Ltd. All rights reserved.

- 12 male runner (5 km run time ~19:29)
- Compression socks (calf: ~37 mmHg, upper ankle: ~31 mmHg, lower ankle: ~23 mmHg)
- Test: Run WU, (5K TT, 60 mins recovery) with/without CG, then 5K TT again
- TT performance

(TT1), a one hour recovery period, then a repeat of the warm-up and 5 km time trial (TT2). One session required the use of sports compression socks during the first warm-up and time trial (COMP), while the other did not (CON).

Results: The decline in run performance in CON from TT1 to TT2 was moderate and significantly greater than that experienced by runners in COMP (9.6 s, $d = 0.67$, $p < 0.01$). No difference was found between experimental conditions for oxygen consumption, blood lactate or calf volume ($p = 0.61, 0.54, 0.64$, respectively). Perceptual measures of muscle soreness, fatigue and recovery were also similar between trials ($p = 0.56, 1.00$ & 0.61 , respectively).

Conclusions: Wearing sports compression socks during high intensity running has a positive impact on subsequent running performance. The underlying mechanism of such performance enhancement remains unclear, but may relate to improved oxygen delivery, reduced muscle oscillation, superior running mechanics and athlete beliefs.

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Sport CG enhance sport performance and recovery!!



Other recent study of CG in sports

THE EFFECT OF GRADUATED COMPRESSION STOCKINGS ON RUNNING PERFORMANCE

AJMOL ALI,¹ ROBERT H. CREASY,² AND JOHANN A. EDGE³

Address correspondence to Dr. Ajmol Ali, a.ali@massey.ac.nz.

25(5)/1385–1392

Journal of Strength and Conditioning Research

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- 12 competitive runners (M: 9)
- 4*10km running time trial
- CMJ (pre & post run)
- Knee length GCS:
 - Low (12-15 mmHg)
 - Medium (18-21 mmHg)
 - High (23-32 mmHg)
 - CON (0 mmHg)

Ali, A, Creasy, RH, and Edge, JA. The effect of graduated compression stockings on running performance. *J Strength Cond Res* 25(5): 1385–1392, 2011–The aim of this study was to examine the effects of wearing different grades of graduated compression stockings (GCS) on 10-km running performance. After an initial familiarization run, 9 male and 3 female competitive runners ($\dot{V}O_{2\max}$ 68.7 ± 5.8 ml·kg⁻¹·min⁻¹) completed 4 10-km time trials on an outdoor 400-m track wearing either control (0 mm Hg; Con), low (12–15 mm Hg; Low), medium (18–21 mm Hg; Med), or high (23–32 mm Hg; Hi) GCS in a randomized counterbalanced order. Leg power was assessed pre and postrun via countermovement jump using a jump mat. Blood-lactate concentration was assessed

GCS. There were no significant differences in performance time between trials ($p = 0.99$). The change in pre to postexercise jump performance was lower in Low and Med than in Con ($p < 0.05$). Mean heart rate ($p = 0.99$) and blood lactate ($p = 1.00$) were not different between trials. Participants rated Con and Low as more comfortable than Med and Hi ($p < 0.01$), Med and Hi were rated as tighter than Low ($p < 0.01$), all GCS were rated as tighter than Con ($p < 0.01$), and Hi was associated with the most pain ($p < 0.01$). In conclusion, GCS worn by competitive runners during 10-km time trials did not affect performance time; however Low and Med GCS resulted in greater maintenance of leg power after endurance exercise.



Other recent study of CG in sports

[RESEARCH REPORT]

FRANCISCO ARECES, MS¹ • JUAN JOSÉ SALINERO, PhD¹ • JAVIER ABIAN-VICEN, PT, PhD¹ • CRISTINA GONZÁLEZ-MILLÁN, PhD¹
 DIANA RUIZ-VICENTE, PhD¹ • BEATRIZ LARA, MS¹ • MARÍA LLEDÓ, PT, PhD¹ • JUAN DEL COSO, PhD¹

The Use of Compression Stockings During a Marathon Competition to Reduce Exercise-Induced Muscle Damage: Are They Really Useful?

462 | JUNE 2015 | VOLUME 45 | NUMBER 6 | JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY

- 34 recreational runners (M: 17)
- Marathon race
- Performance time & pace of marathon
- Pre- and post-CK, CMJ, CK, serum myoglobin
- Compression stockings (foot to below-knee: 25-20 mmHg)
- Conventional socks

● **OBJECTIVES:** To examine the efficacy of wearing compression stockings to prevent muscle damage and to maintain running performance during a marathon competition.

● **BACKGROUND:** Exercise-induced muscle damage has been identified as one of the main causes of the progressive decrease in running and muscular performance found during marathon races.

● **METHODS:** Thirty-four experienced runners were pair-matched for age, anthropometric data, and best race time in the marathon, and randomly assigned to a control group (n = 17) of runners who wore conventional socks or to a group of runners who wore foot-to-knee graduated compression stockings (n = 17). Before and after the race, a sample of venous blood was obtained, and jump

reductions in leg muscle power ($-19.8\% \pm 17.7\%$ versus $-24.8\% \pm 18.4\%$, respectively; $P = .37$) and jump height ($-25.3\% \pm 14.1\%$ versus $-32.5\% \pm 20.4\%$, respectively; $P = .27$) were similar. At the end of the race, there were no differences between the control group and the compression stockings group in serum myoglobin ($568 \pm 347 \text{ ng}\cdot\text{mL}^{-1}$ versus $573 \pm 270 \text{ ng}\cdot\text{mL}^{-1}$, respectively; $P = .97$) and creatine kinase concentration ($390 \pm 166 \text{ U}\cdot\text{L}^{-1}$ versus $487 \pm 227 \text{ U}\cdot\text{L}^{-1}$, respectively; $P = .16$).

● **CONCLUSION:** The use of compression stockings did not improve running pace and did not prevent exercise-induced muscle damage during the marathon. Wearing compression stockings during long-distance running events is an ineffective strategy to avoid the deleterious effects of muscle damage on running performance.



Other recent study of CG in sports

Born et al. *BMC Sports Science, Medicine, and Rehabilitation* 2014, 6:21
<http://biomedcentral.com/2052-1847/6/21>



RESEARCH ARTICLE

Open Access

A novel compression garment with adhesive silicone stripes improves repeated sprint performance – a multi-experimental approach on the underlying mechanisms

Dennis-Peter Born^{1,3*}, Hans-Christer Holmberg², Florian Goernert¹ and Billy Sperlich^{1,3}

- 12 recreational runners (M: 17)
- 30*30m repeated sprints with 1 min rest
- Compression tights (silicon strips): Rectus femoris: 19.0 mmHg/Gastrocnemus medialis: 21.7
- Physiological monitoring, haemoglobin and RPE measurements
- Speed camera and record on muscle activation



Repeated sprint performance is determined by explosive production of power, as well as recovery during successive sprints, and there is evidence that compression garments and sports taping can improve performance.

In each of two sub-studies, female athletes performed two sets of 30 30-m sprints (one wearing a compression garment with adhesive silicone stripes (CGSS) intended to mimic normal clothing, in randomized order. Sub-study 1 (n = 12) focused on cardio-respiratory and perceptual responses, while neuronal and biomechanical parameters were monitored in sub-study 2 (n = 12).

In both sub-studies the CGSS improved repeated sprint performance during the final 10 sprints (P = 0.01, d = 0.61). None of the cardio-respiratory or metabolic variables monitored were altered (P > 0.05, d < 0.1). Also during the final 10 sprints, rating of perceived exertion was reduced (P = 0.01, d = 1.1), step length increased (P = 0.01, d = 0.91) and activation of the rectus femoris (P = 0.01, d = 1.24), while the hip flexion angle was lowered throughout the sprints (P = 0.01, d = 0.28) and step frequency (best P = 0.34, d = 0.2) remained unaltered.

Although the physiological parameters monitored were unchanged, the CGSS improved performance during 30 30-m repeated sprints by reducing perceived exertion and altering muscle activation. **physiological parameters monitored were unchanged**, the CGSS improved performance during 30 30-m repeated sprints by reducing perceived exertion and altering muscle activation. Blood flow, Clothing, Oscillation, Oxygenation, Oxygen uptake, Textile, Tissue saturation, Video analysis

Other recent study of CG in sports

Eur J Appl Physiol (2014) 114:587–595
DOI 10.1007/s00421-013-2789-2

ORIGINAL ARTICLE

Compression stockings do not improve muscular performance during a half-ironman triathlon race

Juan Del Coso · Francisco Areces · Juan José Salinero · Cristina González-Millán · Javier Abián-Vicén · Lidon Soriano · Diana Ruiz · César Gallo · Beatriz Lara · Julio Calleja-Gonzalez

- 36 experienced triathlete
- 19*CG group & 17*CON group
- Half ironman triathlon
- Compression stockings or regular socks
- Performance time, CMJ, CK, blood myoglobin, RPE muscle soreness

Purpose This study aimed at investigating the effectiveness of compression stockings to prevent muscular damage and preserve muscular performance during a half-ironman triathlon.

Methods Thirty-six experienced triathletes volunteered for this study. Participants were matched for age, anthropometric data and training status and placed into the experimental group ($N = 19$; using ankle-to-knee graduated compression stockings) or control group ($N = 17$; using regular socks). Participants competed in a half-ironman triathlon using validated scales.

Results Total race time was not different between groups (315 ± 45 for the control group and 310 ± 32 min for the experimental group; $P = 0.46$). After the race, jump height (0.25 ± 0.02 vs 0.20 ± 0.02 m; $P = 0.17$),

muscle soreness was not different between groups after the race.

Conclusion Wearing compression stockings did not represent any advantage for maintaining muscle function or reducing blood markers of muscle damage during a triathlon event.



Other recent study of CG in sports

The Effects of Wearing Lower Body Compression Garments During a Cycling Performance Test

Matthew W. Driller and Shona L. Halson

International Journal of Sports Physiology and Performance, 2013, 8, 300-306
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Purpose: Compression garments have been commonly used in a medical setting as a method to promote blood flow. Increases in blood flow during exercise may aid in the delivery of oxygen to the exercising muscles and, subsequently, enhance performance. The aim of the current study was to investigate the effect of wearing lower body compression garments during a cycling test. **Methods:** Twelve highly trained cyclists (mean \pm SD age 30 ± 6 y, mass 75.6 ± 5.8 kg, VO_{2peak} 66.6 ± 3.4 mL \cdot kg $^{-1}$ \cdot min $^{-1}$) performed two 30-min cycling bouts on a cycle ergometer in a randomized, crossover design. During exercise, either full-length lower body compression garments (COMP) or above-knee cycling shorts (CON) were worn. Cycling bouts involved 15 min at a fixed workload (70% of VO_{2max} power) followed by a 15-min time trial. Heart rate (HR) and blood lactate (BL) were measured during the fixed-intensity component of the cycling bout to determine the physiological effect of the garments. Calf girth (CG), thigh girth (TG) and perceived soreness (PS) were measured preexercise and postexercise. **Results:** COMP produced a trivial effect on mean power output (ES = .14) compared with CON (mean \pm 95% CI 1.3 ± 1.0). COMP was also associated with a lower HR during the fixed-workload section of the test ($-2.6\% \pm 2.3\%$, ES = $-.38$). There were no differences between groups for BL, CG, TG, and PS. **Conclusion:** Wearing compression garments during cycling may result in trivial performance improvements of $\sim 1\%$ and may enhance oxygen delivery to the exercising muscles.

- 12 highly trained cyclists (VO_{2peak} 66.6 ± 3.4 mL \cdot kg $^{-1}$ \cdot min $^{-1}$)
- 15mins (70% VO_2), then 15mins TT
- Lower-body compression tights during cycling
- Above knee cycling shorts (CON)
- Blood lactate, calf girth, thigh girth, perceived soreness



Other recent study of CG in sports



Calf Compression Sleeves Change Biomechanics but Not Performance and Physiological Responses in Trail Running

Hugo A. Kerhervé^{1,2*}, Pierre Samozino¹, Fabrice Descombe³, Matthieu Pinay¹,
Guillaume Y. Millet⁴, Marion Pasqualini⁵ and Thomas Rupp^{1*}

- 14 male participants
- 3 laps on moderately flat terrain (MFT)
- 2 laps technical and hilly terrain (THT)
- Calf compression sleeves (23±2 mmHg)
- CON (full tights: <4 mmHg)
- Speed, distance, HR, skin temp. delay onset of muscle soreness (VAS)

Results: Muscle oxygenation increased significantly in CS compared to CON at baseline and immediately after exercise ($p < 0.05$), without any difference in deoxygenation kinetics during the run, and without any significant change in run times. Wearing CS was associated with (i) higher aerial time and leg stiffness in running at constant rate, (ii) with lower ground contact time, higher leg stiffness, and higher vertical stiffness in all-out running, and (iii) with lower ground contact time in hopping. Significant DOMS were induced in both CS and CON (>6 on a 10-cm scale) with no difference between conditions. However, Achilles tendon pain was significantly lower after the trial in CS than CON ($p < 0.05$).

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April 2017 | Volume 8 | Article 247

Calf Compression Sleeves during Trail Running

Discussion: Calf compression did not modify muscle oxygenation during ~2 h 30 of trail running but significantly changed running biomechanics and lower limb muscle functional capabilities toward a more dynamic behavior compared to control session. However, wearing compression sleeves did not affect performance and exercise-induced DOMS, while it minimized Achilles tendon pain immediately after running.



Other recent study of CG in sports

Eur J Appl Physiol (2012) 112:1783–1795
DOI 10.1007/s00421-011-2146-2

ORIGINAL ARTICLE

Pressure and coverage effects of sporting compression garments on cardiovascular function, thermoregulatory function, and exercise performance

Braid A. MacRae · Raechel M. Laing ·
Brian E. Niven · James D. Cotter

- 14 male recreationally trained cyclist
- 60min (65% VO_2) followed by 6km TT
- *Whole-body CG: 11-15 mmHg, over-sized CG: 8-13 mmHg, gym-shorts (CON)*
- Exercise cardiac output (CO), Stroke volume (SV), Heart rate (HR)
- Covered skin temp. and core temp.
- TT performance

fixed-load cycling at $\sim 65\%$ $\text{VO}_{2\text{max}}$ and a 6-km time trial. Wearing CG (CSG or OSG) did not mitigate cardiovascular strain during mild orthostatic stress at rest ($p = 0.20\text{--}0.93$ for garment effects). During exercise, cardiac output was $\sim 5\%$ higher in the CG conditions ($p < 0.05$), which appears to be accounted for via non-significant higher end-exercise heart rate ($\sim 4\text{--}7\%$, $p = 0.30$; $p = 0.06$ for greater heart rate drift in CSG); other cardiovascular variables, including stroke volume, were similar among conditions ($p = 0.23\text{--}0.91$). Covered-skin temperature was higher in CG conditions ($p < 0.001$) but core (oesophageal) temperature was not ($p = 0.79$). Time-trial performance (mean power, time taken) was similar with or without CG ($p = 0.24\text{--}0.44$). In conclusion, any demonstrable physiological or psychophysical effects of full-body CG were mild and seemingly reflective more of surface coverage than pressure. No benefit was evident for exercise performance.



Other recent study of CG in sports

Original Paper

DOI: 10.5604/20831862.1150304 Biol. Sport 2015;32:219-223

Long-term effects of graduated compression stockings on cardiorespiratory performance

AUTHORS: Priego JI^{1,2}, Lucas-Cuevas AG¹, Aparicio I¹, Giménez JV¹, Cortell-Tormo JM³, Pérez-Soriano P¹

ABSTRACT: The use of graduated compression stockings (GCS) in sport has been increasing in the last years due to their potential positive effects for athletes. However, there is little evidence to support whether these types of garments actually improve cardiorespiratory performance. The aim of this study was to examine the cardiorespiratory responses of GCS during running after three weeks of regular use. Twenty recreational runners performed three tests on different days: test 1) – a 5-min maximal effort run in order to determine the participants' maximal aerobic speed; and tests 2) and 3) – a fatigue running test of 30 minutes at 80% of their maximal aerobic speed with either GCS or PLACEBO stockings at random. Cardiorespiratory parameters (minute ventilation, heart rate, relative oxygen consumption, relative carbon dioxide production, ventilatory equivalents for oxygen and carbon dioxide, and oxygen pulse) were measured. Before each test in the laboratory, the participants trained with the randomly assigned stockings (GCS or PLACEBO) for three weeks. No significant differences between GCS and PLACEBO were found in any of the cardiorespiratory parameters. In conclusion, the present study provides evidence that running with GCS for three weeks does not influence cardiorespiratory parameters in recreational runners.

- 20 recreational runner (M: 13)
- GCS (ankle:24 mmHg and Knee: 21 mmHg; manufacturer information)
- 3 weeks of training with GCS or placebo garment (Randomly assigned)
- 5 mins max effort run
- Ventilation per min
- Heart rate (HR)
- VO₂ per kg
- VCO₂ per kg



Other recent study of CG in sports



European Journal of Sport Science, 2018
Vol. 18, No. 3, 315–322, <https://doi.org/10.1080/17461391.2017.1413139>



ISSN: 1746-1391 (Print) 1536-7290 (Online) Journal homepage: <http://www.tandfonline.com/loi/tejs20>

Compression garments and cerebral blood flow: Influence on cognitive and exercise performance

Brittany A. Smale, Joseph M. Northey, Disa J. Smee, Nathan G. Versey & Ben Rattray

Abstract

This study aimed to describe the effect of compression garments on middle cerebral artery blood flow velocity (MCA_v) in relation to cognitive and exercise performance whilst cycling. In a randomised-controlled-cross-over design, 15 well-trained male cyclists were recruited to participate in three identical trials wearing loose fitting shorts (control), low-grade, or medium-grade compression garments. The protocol involved four 8 min increments of cycling at 30%, 50%, 70%, and 85% maximal power output and a 4 km time-trial. Participants undertook a cognitive Stroop task at baseline and at the midpoint of each increment. MCA_v was monitored with Transcranial Doppler Ultrasonography. Mean arterial pressure (MAP) and partial pressure of end-tidal CO₂ (P_{et}CO₂) were measured throughout. MCA_v, MAP, P_{et}CO₂, and reaction time of the complex Stroop task were influenced by exercise intensity, but not compression garments. Compression garments significantly affected cognitive accuracy in the complex Stroop task such that low-grade compression appeared to enhance cognitive accuracy in comparison to the control condition at the highest intensity ($p = .010$). Time-trial performance did not differ between the control (338.0 ± 17.3 s), low-grade (338.7 ± 18.7 s), or medium-grade (342.2 ± 19.3 s) conditions ($p = .114$). Compression garments did not affect MCA_v during exercise or time-trial performance, but compression may be beneficial for improved cognitive accuracy during high-intensity exercise. Further research is required to elucidate the potential impact on cognitive performance.

- 15 well-trained cyclists (Maximal power output 339 ± 39 W)
- Loose fitting shorts
- Low compression tights
- Med compression stockings
- 3*intervention trials: (30, 50, 70, 85% PPO Loading, 5-min recovery, then 4km TT)
- Stroop test at each stage
- MAP, cerebral blood flow, lactate, etc.



Other recent study of CG in sports

Journal of Sports Sciences, April 2010; 28(6): 609–614



Different types of compression clothing do not increase sub-maximal and maximal endurance performance in well-trained athletes

BILLY SPERLICH¹, MATTHIAS HAEGELE¹, SILVIA ACHTZEHN¹, JOHN LINVILLE², HANS-CHRISTER HOLMBERG³, & JOACHIM MESTER¹

- 15 well-trained athlete ($\text{VO}_{2\text{max}}$ $63.7 \pm 4.9 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$)
- Compression socks
- Compression tights
- Whole-body compression
- No exerted pressure provided
- 15 mins running at $\sim 70\% \text{VO}_{2\text{max}}$, then run to volitional exhaustion (fixed velocity)

Three textiles with increasing compressive surface were compared with non-compressive conventional clothing on physiological and perceptual variables during sub-maximal and maximal running. Fifteen well-trained endurance athletes (mean \pm s: age 27.1 ± 4.8 years, $\dot{\text{V}}\text{O}_{2\text{max}}$ $63.7 \pm 4.9 \text{ mL} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) performed four sub-maximal ($\sim 70\% \dot{\text{V}}\text{O}_{2\text{max}}$) and maximal tests with and without different **compression stockings, tights, and whole-body compression suits**. Arterial lactate concentration, oxygen saturation and partial pressure, pH, oxygen uptake, and ratings of muscle soreness were recorded before, during, and after all tests. In addition, we assessed time to exhaustion. Sub-maximal ($P=0.22$) and maximal oxygen uptake ($P=0.26$), arterial lactate concentration ($P=0.16$; 0.20), pH ($P=0.23$; 0.46), oxygen saturation ($P=0.13$; 0.26), and oxygen partial pressure ($P=0.09$; 0.20) did not differ between the types of clothing (effect sizes = 0.00 – 0.45). Ratings of perceived exertion ($P=0.10$; 0.15), muscle soreness ($P=0.09$; 0.10) and time to exhaustion ($P=0.16$) were also unaffected by the different clothing (effect sizes = 0.28 – 0.85). This was the **first study to evaluate the effect on endurance performance of different types of compression clothing with increasing amounts of compressive surface**. Overall, there were **no performance benefits when using the compression garments**.



The effectiveness of CG in sports application?!



Claimed benefits

| Pros (did) | Cons (did not) |
|--|---|
| <ul style="list-style-type: none"> • Reduce perceived muscle soreness; (Mizuno et al., 2017) • Enhance neurotransmission; (Barss et al., 2018) • Attenuate muscle oscillation; (Kraemer et al., 1998) • Improve joint awareness; (Šambaher et al., 2016) • Mitigate swelling; (Kraemer et al., 2001) • Enhance subsequent exercise performance; (Brophy-Williams et al., 2019; Gimenes et al., 2019) • Improve sub-maximal oxygen usage; (Bringard et al., 2006; Dascombe et al., 2011) • Alter local blood flow/metabolite clearance; (Miyamoto & Kawakami, 2014) • Attenuate exercise-induced muscle damage blood biomarkers. (Gill et al., 2006) | <ul style="list-style-type: none"> • Improve performance time (Ali et al., 2011) • Improve running pace (Arcecs et al., 2015) • Prevent exercise-induced muscle damage (Arcecs et al., 2015) • Improve blood biomarkers e.g. CK, lactate, blood myoglobinduring exercise (Arcecs et al., 2015; Born et al., 2014; Del Coso et al., 2014; Kerherve et al., 2017) • Improve cycling performance (Driller et al., 2013; MacRae et al., 2012; Smale et al., 2018) • Have training effects on cardiorespiratory parameters (Priego et al., 2015) • Affect middle cerebral blood flow (Smale et al., 2018) • Improve endurance performance (Sperlich et al., 2010) |



Systematic review and meta-analysis




Recent published studies

©Journal of Sports Science and Medicine (2015) 14, 75-83
<http://www.jssm.org>

Review article

Compression Garments and Exercise: No Influence of Pressure Applied

Samuel Beliard ^{1,2,3}, Michel Chauveau⁴, Timothée Moscatiello⁴, François Cros⁴, Fiona Ecartot² and François Becker⁵



High-
bounces:

Is There Evidence that Runners can Benefit from W Compression Clothing?

Florian Azad Engel¹ • Hans-Christer Holmberg² • Billy Sperlich³

Sports. Athletic
Performance
and Recovery



Review and Meta-Analysis on sports CG

- Relatively *few ergogenic effects*;
(Born et al., 2013; Brown et al., 2017; Engel et al., 2016)
- *Small effects* on improving short duration sprints (10-60 m), vertical-jump height;
(da Silva et al. 2018)
- *Large positive effects* on post-exercise leg soreness, strength recovery and attenuate the concentration of Creatine Kinase.
(Hill et al., 2014; MacRae et al., 2011)
- *No apparent relation* between the effects of CG.....and the pressures applied;
(Beliard et al., 2015)



Factors affecting effectiveness of CG



Consumer Council report (15/05/2019)

- 消委會測試壓力襪：部分有反效果、阻血液上流
- https://www.youtube.com/watch?v=rVsN-Sh_piM



Compression pressure from CG

Sports Eng
DOI 10.1007/s12283-015-0170-x

ORIGINAL ARTICLE

The variation in pressures exerted by commercially available compression garments

Jessica A. Hill · Glyn Howatson · Ken A. van Someren ·
Stuart Davidson · Charles R. Pedlar

Published online: 28 January 2015

- 50 healthy individuals (M: 24)
- Fitted with CG according to manufacturer's guidelines
- Exerted COMP was measured in standing then compared to ideal COMP

COMP: compression pressure

Abstract Commercially available compression garments (CGs) demonstrate the enhanced recovery from exercise in some, but not all studies. It is possible that in some cases the degree of compression pressure (CompP) exerted is not sufficient to produce any physiological benefit. The aim of this investigation was to identify the levels of CompP exerted by commercially available CGs. This study was composed of two parts. In part A 50 healthy, physically active individuals ($n = 26$ male, $n = 24$ female) were fitted with CGs according to manufacturer's guidelines. CompP was measured in participants standing in the morning.

there was a significant difference ($P < 0.05$) between observed pressure and ideal pressure at the quadriceps for males and females and in the calf for the female population. There was no significant difference ($P > 0.05$) between observed and ideal pressures in the calf of the male population. No significant differences in pressure ($P > 0.05$) were observed between CG brands at the quadriceps or calf. In conclusion, a large number of individuals may not be experiencing an adequate CompP from CG, and this is true for all the three major brands of CGs tested in this investigation.



Compression pressure from CG

Journal of Sports Sciences, 2014
<http://dx.doi.org/10.1080/02640414.2014.990489>



Confounding compression: the effects of posture, sizing and garment type on measured interface pressure in sports compression clothing

NED BROPHY-WILLIAMS^{1,2}, MATTHEW WILLIAM DRILLER^{2,3},
CECILIA MARY SHING², JAMES WILLIAM FELL² & SHONA LOUISE HALSON^{1,2}

- 12 national-level male boxers
- Fitted with sport CGs according to manufacturer's guidelines
- Tights and leggings
- Oversized, recommended size, undersized
- Standing, sitting, supine posture
- Across 6 landmarks
- Measured interface pressure with pressure monitor

Abstract

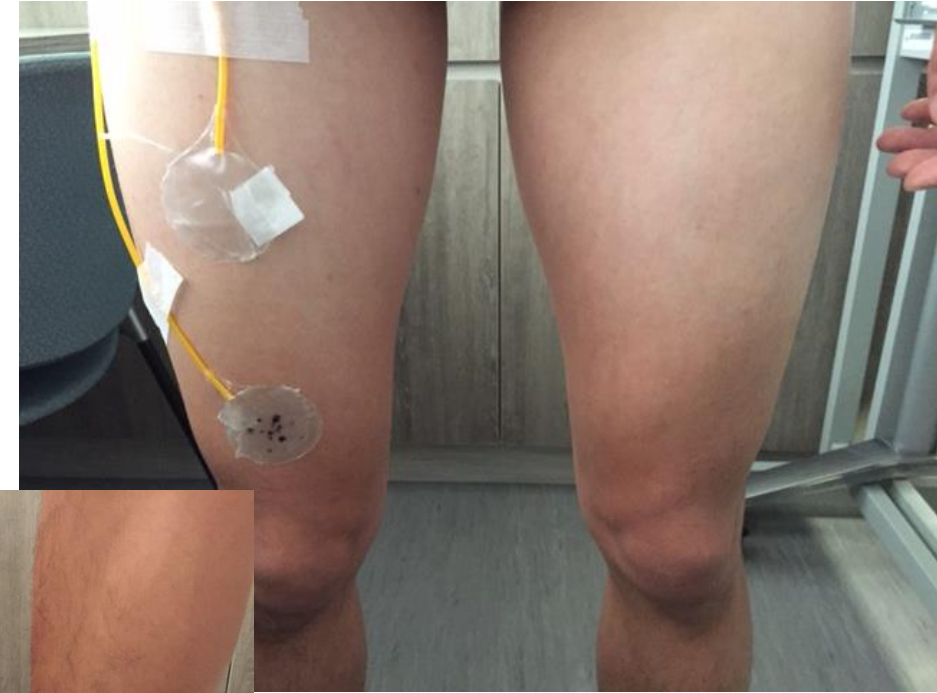
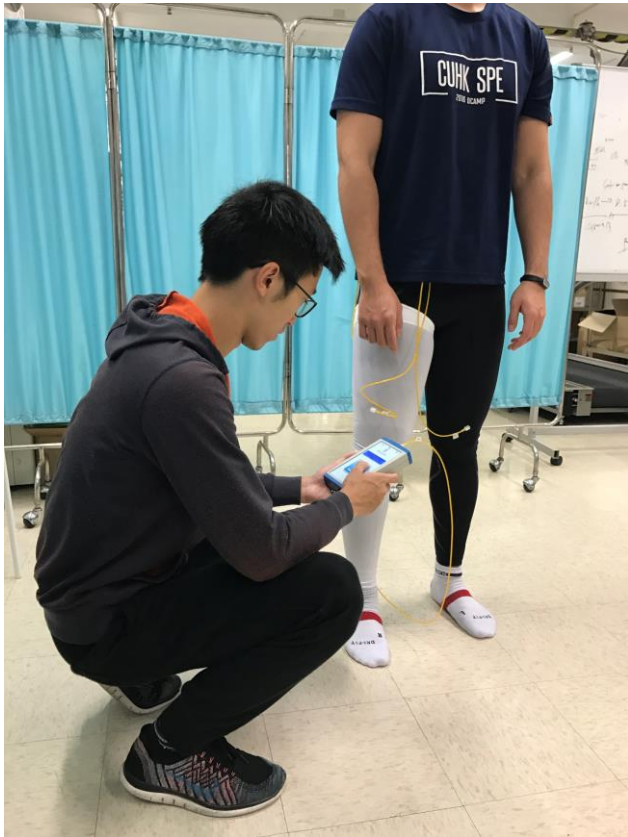
The purpose of this investigation was to measure the interface pressure exerted by lower body sports compression garments, in order to assess the effect of garment type, size and posture in athletes. Twelve national-level boxers were fitted with sports compression garments (tights and leggings), each in three different sizes (undersized, recommended size and oversized). Interface pressure was assessed across six landmarks on the lower limb (ranging from medial malleolus to upper thigh) as athletes assumed sitting, standing and supine postures. Sports compression leggings exerted a significantly higher mean pressure than sports compression tights ($P < 0.001$). Oversized tights applied significantly less pressure than manufacturer-recommended size or undersized tights ($P < 0.001$), yet no significant differences were apparent between different-sized leggings. Standing posture resulted in significantly higher mean pressure application than a seated posture for both tights and leggings ($P < 0.001$ and $P = 0.002$, respectively). Pressure was different across landmarks, with analyses revealing a pressure profile that was neither strictly graduated nor progressive in nature. The pressure applied by sports compression garments is significantly affected by garment type, size and posture assumed by the wearer.



Compression pressure (COMP) measurement



PicoPress[®] (MICROLAB ELETTRONICA S.a.s. di Bergamo Giorgio & C.)



Compression Level Chart

| Range | EU standard | UK standard | US standard |
|---------------------------|----------------------------|----------------------------|----------------------------|
| Extra mild (<14 mmHg) | | | |
| Mild (14-17 mmHg) | | UK Class 1 (14-17 mmHg) | |
| Moderate (18-24 mmHg) | EU Class 1 (18-21 mmHg) | UK Class 2 (18-24 mmHg) | US Class 1 (15-20 mmHg) |
| Strong (25-35 mmHg) | EU Class 2 (23-32 mmHg) | UK Class 3 (25-35 mmHg) | US Class 2 (20-30 mmHg) |
| Very strong (>35 mmHg) | EU Class 3 (34-46 mmHg) | | US Class 3 (30-40 mmHg) |

(O'Meara et al, 2012)



Research gap of CG?!



Research gap of CG in healthy individuals

Existing evidences of wearing sports CG

- Inconsistency in results due to discrepancies in pressure applied, type of CG, sex, etc., between studies;
(Brophy-Williams et al., 2015; Hill et al., 2015)
- Limited data on morphological changes (vessels and muscles) of the human leg with CG application;
(Lee et al. 2018; MacRae et al., 2012; Wang et al., 2012; Wang et al., 2013)
- Conflicting findings on local and systemic hemodynamic responses i.e. CO, HR, SV, MAP, SVR;
(Ibegbuna et al., 2003; Platts et al., 2009; Stenger et al., 2010; Stenger et al., 2013; Stenger et al., 2014; Watanuki et al. 1994;)
- A lack of study monitoring hemodynamic responses during recovery.
(Avril et al., 2010; Bringard et al., 2006)



Research gap of CG in healthy individuals

Wearing of sports CG

- Efficacy of CG wearing in *hemodynamic responses* during exercise and recovery;
(Lee et al., 2018; MacRae et al., 2011; MacRae et al., 2012)
- Leg tissue (muscles and SAT) responses to compression pressures;
(Lee et al., 2018; Wang et al., 2012; Wang et al., 2013)
- Applied pressure and the associated hemodynamic responses;
(Chan et al., 2016; O'Meara et al., 2012; Rohan et al., 2013)
- Practical recommendation for CG wearing in exercise and recovery.
(Ali et al., 2010; Avril et al., 2010; Del Coso et al., 2014)

CG: sport compression garment; SAT: subcutaneous adipose tissue.



CG researches of the CUHK



Sports CG and Hemodynamic Responses

Journal of Science and Medicine in Sport 21 (2018) 1062–1067



Original research

Haemodynamic responses of wearing low-pressure sports compression tights during an orthostatic challenge in healthy individuals

Daniel C.W. Lee^a, Shara W.Y. Lee^b, Kim Khaw^c, Ajmol Ali^{a,d}, Sinead E. Sheridan^e, Stephen H.S. Wong^{a,*}



- 33 healthy college student (M: 18)
- Without history of unexplained syncope
- Sports compression tights (CT: 7.2 - 18.6 mmHg)
- Loose-fitting track pants (CON: <2 mmHg)
- Monitoring of cardiac output (CO), stroke volume (SV), heart rate (HR), systemic vascular resistance (SVR) and mean arterial pressure (MAP) with USCOM
- At supine and an head up tilt test (HUT)

pants (CON). Stroke volume (SV) and cardiac output (CO) were measured non-invasively using USCOM; heart rate (HR) and non-invasive blood pressure were measured, and systemic vascular resistance (SVR) was derived.

Results: The SV and CO was lower at 70° head-up tilt than in supine but wearing CT attenuated the decline in SV ($25.9 \pm 11.6 \text{ cm}^3$ CT vs. $35.9 \pm 11.4 \text{ cm}^3$ CON, $p < 0.001$), CO ($1.1 \pm 0.7 \text{ L min}^{-1}$ CT vs. $1.4 \pm 0.6 \text{ L min}^{-1}$ CON, $p < 0.05$), HR ($8.8 \pm 8.4 \text{ beat min}^{-1}$ CT vs. $15.9 \pm 9.7 \text{ beat min}^{-1}$ CON, $p < 0.001$) and SVR ($740 \pm 504 \text{ d s cm}^{-5}$ CT vs. $961 \pm 560 \text{ d s cm}^{-5}$ CON, $p < 0.005$). The mean arterial pressure ($3.3 \pm 4.1 \text{ mmHg}$ CT vs. $3.6 \pm 4.5 \text{ mmHg}$ CON, $p > 0.05$) was similar in both trials.

Conclusions: Healthy individuals wearing low-pressure sports compression tights experienced less severe haemodynamic disturbance such as decreases in CO, SV, HR and SVR during an orthostatic challenge.

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USCOM: ultrasound cardiac output monitor



Take home message

In physically active and healthy population, wearing sports CG according to manufacturer guidelines could have:

- Relatively *few ergogenic effects*;
(Born et al., 2013; Brown et al., 2017; Engel et al., 2016)
- *Small effects* on improving short duration sprints (10-60 m), vertical-jump height;
(da Silva et al. 2018)
- *Large positive effects* on post-exercise leg soreness, strength recovery and attenuate the concentration of Creatine Kinase;
(Hill et al., 2014; MacRae et al., 2011)
- No detrimental effects on exercise performance.
(MacRae et al., 2011)



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MR DANIEL CHI-WO LEE

李致和講師

Position: Lecturer
Address: Rm G01B, Kwok Sports Building,
The Chinese University of Hong Kong,
Shatin, N.T., HONG KONG
Telephone: (852) 3943 7157
Email: dcwlee@cuhk.edu.hk



Thank You

