

JEPonline
Journal of Exercise Physiologyonline

**Official Journal of The American
Society of Exercise Physiologists (ASEP)**

ISSN 1097-9751

An International Electronic Journal
Volume 7 Number 2 April 2004

Exercise and Health

DOES FOUR-LIMB COMPRESSION HAVE A BENEFICIAL EFFECT ON MOOD STATE?

COX RH¹, THOMAS TR², VOLKER S², AOYAGI MW¹

¹ Educational, School and Counseling Psychology, University of Missouri-Columbia; ² Exercise Physiology Laboratory, University of Missouri-Columbia.

ABSTRACT

DOES FOUR-LIMB COMPRESSION HAVE A BENEFICIAL EFFECT ON MOOD STATE? **Cox RH, Thomas TR, Volker S, Aoyagi, MW.** *JEPonline*. 2004;7(2):25-29. The purpose of this investigation was to study the effects of four-limb compression on the psychological mood of recipients. Participants were eight middle-aged individuals with previous coronary artery disease, and 12 healthy controls. Each participant received 45 min of compression treatment each day for 15 days. Participants completed the Profile of Mood States (POMS) before and after treatment on days 1 and 15. Univariate data from the POMS were analyzed using a group by gender by day by time (2 x 2 x 2 x 2) ANOVA with repeated measures on the day and time. With the exception of fatigue, all of the tests of significance for the POMS sub-scales were insignificant. In the case of fatigue, only the interaction between day and time ($p = 0.008$) and the interaction between day, time and groups ($p = 0.0006$) were significant. The day by time interaction for healthy participants was not significant, but the day by time interaction for the cardiac participants was ($p = 0.003$). For the cardiac participants, a significant difference between pre and post-tests was observed on day 1 ($p = 0.0004$). Also, for the cardiac participants, a significant difference between days was observed for pre-test ($p = 0.036$). For the cardiac participants, it appears that applying compression treatment to the limbs results in a reduction in perceived fatigue.

Key Words: POMS, CHD, Fatigue, Psychology

INTRODUCTION

The application of external compression to the limbs has been used for many years to improve cardiovascular function. Researchers and clinicians have used pneumatic compression instruments to apply intermittent pressure to the limbs to improve hemodynamics and to prevent deep vein thrombosis after surgery (1,2). Intermittent pneumatic compression has been sequenced such that the pressure was applied from the distal to the proximal parts of the limb. The wavelike action elicited higher peak venous blood flow velocities over the standard compression technique (3). Most recently, it was demonstrated that 15-days of intermittent pressure

results in a decrease in blood pressure and prostacyclin, but no change in nitric oxide or fibrinolytic markers (4).

While previous research seems to show that intermittent pneumatic limb compression results in improved cardio-dynamics and a reduction in blood pressure similar to mild exercise, little is known about the effects of limb-compression on psychological measures. Indeed, despite an extensive literature review no articles were found which investigated the relationship between limb compression and psychological factors. This was somewhat surprising considering the vast array of literature produced on the beneficial effects even mild exercise can have on mood.

Given the lack of literature on limb compression, the literature review focused on studies in which massage therapy was used in a similar fashion to limb compression (i.e., to increase blood flow). One such example utilized children and adolescents who had been diagnosed with either an adjustment disorder or depression (5). Participants received a 30-min Swedish massage once per day for five days, and completed psychological inventories prior to and after receiving the massage. Immediately following massage therapy, depression and state anxiety were significantly reduced. Further, state anxiety and depression both demonstrated a significant decrease from day one to day five. Similarly, a study of adult burn patients who received 30 minutes of massage therapy twice a week for five weeks found a significant reduction in depression after the first day of massage therapy as well as from the first day to the last day of massage therapy (6).

In non-clinical populations, massage therapy has been shown to be efficacious as well. Field et al. (7) studied the effects of a 15-min chair massage given two times per week for five weeks on adult participants as well as a control group. It was found that immediately following the massage, anxiety levels were lower for the massage group but not for the control group, and depression scores were lower for both groups. At the conclusion of the five-week period, both groups displayed reduced depression scores as measured by the POMS, but the massage group scored lower on job stress. Another study investigated the effects of massage on pain and stress experienced by hospital staff (8). Participants received up to eight Swedish massage treatments of 15-min. Psychological measures were administered prior to and after each massage session. The researchers found pain intensity and tension levels to be significantly lower following massage, while relaxation and overall mood state improved after massage. Likewise, Weinberg, Jackson, and Kolodny (9) used college students enrolled in physical activity classes to examine the effects of a 30-min Swedish massage, 30-min of exercise, and a control rest group on mood. Massage participants displayed significant reductions in tension, confusion, fatigue, anxiety, depression, and anger following the massage, similar to the results found in the exercise group. The control group did not display any significant differences in mood.

Although limb compression has been largely overlooked in the psychological literature, it has been proposed as a short-term substitute for exercise therapy in patients with heart disease (4). Therefore, the purpose of this investigation was to study the effects of four-limb compression on the psychological mood of subjects with previous coronary artery disease and apparently healthy controls. We hypothesized that limb compression would improve some indices of psychological mood. In particular, we hypothesized that 15-days of limb compression treatment should have a beneficial effect upon tension, vigor and fatigue, and that the effect of compression would be magnified in the cardiac patients versus controls.

METHODS

Subjects

Twenty subjects were recruited for this study including eight middle-aged subjects with previous coronary artery disease (4 females & 4 males) and 12 healthy controls (7 females & 5 males), with a mean age of 59.8 ± 6.9 years and ranging from 47 to 70 years (see Table 1). The cardiac subjects had normal left ventricular function with an ejection fraction of 55 % or higher and no significant valve-related regurgitant lesions. Patients with significant stenotic lesions or prosthetic valves were not included. Members of the cardiac group had a

previous myocardial infarction or had undergone coronary artery bypass surgery or percutaneous coronary intervention.

Table 1. Subject characteristics.

	<i>Females</i>			<i>Males</i>			<i>All Subjects</i>
	<i>Total</i>	<i>Healthy</i>	<i>Cardiac</i>	<i>Total</i>	<i>Healthy</i>	<i>Cardiac</i>	
<i>Age (yr)</i>	57.6 ? 7.3	54.7 ? 5.8	62.8 ? 7.5	62.4 ? 6.2	60.0 ? 7.5	65.5 ? 2.4	59.8 ? 7.1
<i>Weight (kg)</i>	69.5 ? 17.7	72.7 ? 20.8	64.0 ? 10.7	87.7 ? 16.6	95.2 ? 18.8	78.3 ? 6.9	77.7 ? 19.1
<i>Height (cm)</i>	164.2 ? 6.2	166.4 ? 4.6	160.3 ? 7.4	177.3 ? 6.7	181.4 ? 6.1	172.3 ? 3.0	170.1 ? 9.2

The mean time since an infarction and/or surgery for the cardiac subjects was 25.5 months. Neither controls or cardiac patients were on any anti-coagulant or vasodilating drugs, although, most patients were taking coated aspirin daily. Nor did they have any painful arthritic conditions. All cardiac patients were taking a beta-receptor blocker. For control subjects, individuals were recruited who were apparently healthy, non-smokers, with no history of cardiovascular disease. Prior to intervention, all subjects were performing mild to moderate aerobic exercise 3-4 times/week.

Testing protocol

Prior to testing, each subject completed health history, medical, and physical activity questionnaires. The research study was approved by the campus Institutional Review Board (IRB), and participants gave written informed consent prior to participation. Participants were instructed to avoid caffeine, aspirin, and exercise the day of the testing. In addition to psychological testing, data were gathered on heart rate, cardiac output, and various blood composition indicators. Results of psychological testing are reported in this research report. Results associated with physiological measures are reported elsewhere (4).

Profile of Mood States

Psychological mood was measured using McNair, Lorr and Droppleman's (10) Profile of Mood States (POMS). The POMS is a 65-item inventory that measures the mood states of tension, depression, anger, vigor, fatigue, and confusion. In addition, a total POMS score was calculated by summing the negative mood scores, subtracting the vigor score, and adding a constant of 100 to avoid negative scores. The internal consistency of the six sub-scales ranges from 0.84 to 0.95, while the test-retest stability of the instrument ranges from 0.65 to 0.74. Numerous studies have documented the predictive and construct validity of the POMS (10).

Limb Compression and Measurement of Mood

Each participant underwent 15 consecutive days of compression treatment using a compression instrument (Noninvasive Circulation Enhancer, Inc., Riverdale, NY). The subject sat in the instrument in a semi-reclining position, and plastic cuffs were placed on the entire length of the arms and legs. The compression cycle consisted of inflation and deflation cycles of 2 lbs/inch² (approximately 100 mmHg). The cycles alternated between starting the inflation cycle in the arms or in the legs. For example, when the inflation cycle began with the legs, the cuffs in the legs inflated and then after 20 s, the arm cuffs inflated. Then both remained inflated for another 65 s. At that time, the leg and arm cuffs deflated and remained deflated for 20 s, and the cycle began again starting with the arms. Each participant received 45 min of compression treatment each day for 15 days. On days 1 and 15, mood state data was collected on each subject before and after the compression session.

Statistical Analyses

Mood data were analyzed using seven separate group by gender by day by time (2x2x2x2) ANOVAs with repeated measures on the day and time variables. The dependent variables for the seven analyses included the six sub-scales of the POMS (tension, depression, anger, vigor, fatigue, confusion) and a total POMS score. Because of the many tests of significance associated with multiple four factor ANOVAs, a conservative alpha of $p = 0.01$ was adopted to minimize inflated type I error rate. Effect size, or strength of relationship associated with significant main effects, interactions, and mean comparisons were reported using partial eta-squared (η^2_p) (11).

RESULTS

Tests of significance for all main effects and interactions for the total POMS score as well as for tension, depression, anger, vigor and confidence were not significant. In the case of perceived psychological fatigue, the interactions between day and time, $F(1, 16) = 9.03, p = 0.008, \eta^2_p = 0.36$, and between day, time and group, $F(1, 16) = 18.37, p = 0.001, \eta^2_p = 0.54$ were significant. Subsequent analyses of the day by time interaction for the healthy and cardiac participants for fatigue revealed a significant interaction for the cardiac group, $F(1, 7) = 20.05, p = 0.003, \eta^2_p = 0.74$, but not for the healthy group. The nature of the interaction between day and time for the cardiac group is illustrated in Figure 1. Simple comparisons between means in Figure 1 revealed a significant difference between time 1 and time 2 for day 1 ($p=0.0004, \eta^2_p = 0.72$) and a borderline significant difference between day 1 and day2 for time 1 ($p=0.036, \eta^2_p = 0.49$). Means and standard deviations associated with the significant day by time by group interaction for fatigue are displayed in Table 2.

The main effect means and standard deviations for gender were 2.56?2.55 and 2.18?2.63 respectively for males and females; while the main effect means and standard deviations for groups were 2.25?2.66 and 2.50?2.51 respectively for healthy and cardiac participants.

DISCUSSION

Results did not support the hypotheses that limb compression has a beneficial effect on psychological mood generally, or for tension, depression, anger, vigor, or confusion. However, there was evidence to support the hypothesis that fatigue is reduced in the cardiac participants. A similar reduction in fatigue was observed in the Weinberg, Jackson, and Kolodny (9) study in which college students received massage therapy. Thus, it appears types of massage or muscular compression have beneficial effects on reducing fatigue. However, the results of the present investigation did not mirror the reduced tension found in the massage group of the Weinberg, Jackson, and Kolodny (9) study. One possible explanation for this difference was the compression instrument itself. When the machine was running it was quite noisy, and this noise was probably not conducive to a perceived reduction in tension.

It should also be noted that all subjects in the present investigation were participating in mild to moderate aerobic exercise 3-4 times/week. Thus, the exercise level of the participants may have masked the potentially beneficial effects of limb compression. Because limb compression is proposed as a short-term substitute for

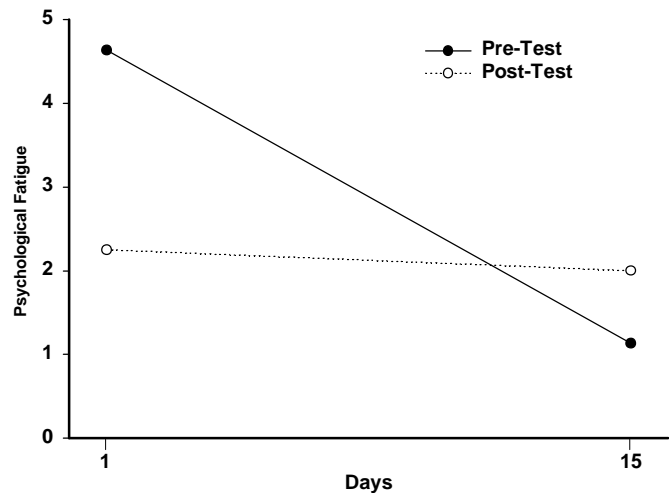


Figure 1. Nature of day by time interaction. Significant differences observed between day 1 and 15 for pretest, and between pre and post-test for day 1.

Table 2. Means and Standard Deviations Associated with the Groups by Day by Time Interaction for Fatigue.

Day	Time	Groups	
		Healthy	Cardiac
Day 1	Pre-test	2.4 ? 3.4	4.6? 4.1
	Post-test	3.1 ? 3.8	2.3 ? 3.6
Day 15	Pre-test	1.7 ? 2.5	1.1 ? 2.1
	Post-test	1.8? 2.5	2.0 ? 2.2

exercise therapy among cardiac patients unable to participate in exercise (4), the psychological effects may be greater in this population.

CONCLUSIONS

For the cardiac participants, it appears that applying compression treatment to the limbs results in a reduction in perceived fatigue. Future studies should target cardiac patients who are unable to participate in aerobic exercise. Furthermore, it is recommended that ear plugs or some strategy to minimize the distracting effects of noise produced by the compression machine be employed in future investigations.

ACKNOWLEDGMENTS

This research was supported by Non-Invasive Circulation Enhancer, Inc. The authors thank Mr. R. Waudby and Drs. F. Alva and S. Nathan for assistance with data collection.

Address for correspondence: Cox RH, Ph.D., Department of Educational, School and Counseling Psychology, 16 Hill Hall, University of Missouri-Columbia, Columbia, MO, USA, 65211. Phone: (573) 882-7602; FAX: (573) 884-5989; Email: coxrh@missouri.edu.

REFERENCES

1. Kierkegaard A and Norgren L. Graduated compression stockings in the prevention of deep venous thrombosis in patients with acute myocardial infarction. *Eur Heart J* 1993;14:1365-1368.
2. Tarnay TJ, Rohr PR, Davidson AG, Stevenson MM, Byars EF and Hopkins GR. Pneumatic calf compression, fibrinolysis, and the prevention of deep venous thrombosis. *Surgery* 1980;489-496.
3. Janssen H, Trevino C and Williams D. Hemodynamic alterations in venous blood flow produced by external pneumatic compression. *Cardiovasc Surg* 1993;441-447.
4. Thomas TR, Whiteman D, Zhang JQ, Fritche KL, Messimer, HL, Cox RH, Hess DB, Smith BK and LaFontaine, TP. Does four limb compression mimic the effects of exercise? *J Exer Physiol* 2002;5:32-41.
5. Field TM. Reducing stress in child and psychiatric patients by relaxation therapy and massage. In: Field TM, McCabe PM, editors. **Stress and coping in infancy and childhood**. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc. 1992:219-32.
6. Field T, Peck M, Hernandez-Reif M, Krugman S, Burman I and Ozment-Schenck L. Postburn itching, pain, and psychological symptoms are reduced with massage therapy. *J Burn Care Rehab* 2000;21:189-93.
7. Field T, Ironson G, Scafidi F, Nawrocki, T, Goncalves A, Burman I et al. Massage therapy reduces anxiety and enhances EEG pattern of alertness and math computations. *International J Neuroscience* 1996;86:197-205.
8. Katz J, Wowk A, Culp D and Wakeling H. Pain and tension are reduced among hospital nurses after on-site massage treatments: A pilot study. *J Perianesthesia Nursing* 1999;14:128-33.
9. Weinberg R, Jackson A and Kolodny K. The relationship of massage and exercise to mood enhancement. *The Sport Psychologist* 1988;2:202-11.
10. McNair DM, Lorr M and Droppleman LF. **Profile of Mood States manual**. San Diego: Education and Industrial Testing Service, 1992.
11. Tabachnick BG and Fidell LS. **Using multivariate statistics**. Boston: Allyn and Bacon, 2001.