

Spring 1991

A Physiologic Evaluation of the Sports Massage

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Recommended Citation

Boone, T., R. Cooper, and W.R. Thompson: A physiologic evaluation of the sports massage, JOURNAL OF THE NATIONAL ATHLETIC TRAINING ASSOCIATION, 26: 1991, 51-54. http://www.athletictraininghistory.com/nata/journals/NATA_Journal_VOL_26_01_1991%20sm.pdf

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ATHLETIC TRAINING

THE JOURNAL OF THE NATIONAL ATHLETIC TRAINERS' ASSOCIATION, INC. • VOLUME 26 • NUMBER 1 • SPRING 1991



ATHLETIC TRAINING

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Athletic Training, JNATA (ISSN 0 160 8320) is published quarterly (\$28 for one year subscription, \$35 foreign) by the National Athletic Trainers' Association, Inc., 2952 Stemmons Freeway, Dallas, TX 75247. Second-class postage paid at Dallas, TX and at additional mailing offices. POSTMASTER: Send address changes to: *Athletic Training, JNATA* c/o NATA, 2952 Stemmons Freeway, Dallas, TX 75247. CHANGE OF ADDRESS: Request for address change must be received 30 days prior to date of issue with which it is to take effect. Duplicate copies cannot be sent to replace those undelivered as a result of failure to send advance notice. Send address changes to: *Athletic Training, JNATA* c/o NATA, 2952 Stemmons Freeway, Dallas, TX 75247. ADVERTISING: Although advertising is screened, acceptance of the advertisement does not necessarily imply NATA endorsement of the product or the views expressed. Advertising rates available upon request. The views and opinions in *Athletic Training, JNATA* are those of authors and not necessarily of the National Athletic Trainers' Association, Inc. Copyright 1991 by the National Athletic Trainers' Association, Inc. (ISSN 0 160 8320). All rights reserved. Printed by The William Byrd Press, Richmond, VA 23227. Typesetting by the Virginia Health Council, Inc., Richmond, VA, 23221.

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A Physiologic Evaluation of the Sports Massage

Tommy Boone, PhD

Rae Cooper, MS

Walter R. Thompson, PhD

ABSTRACT: *This study determines the physiological responses of 10 healthy college-age subjects during submaximal exercise on the treadmill with and without a prior 30-minute sports massage. The Beckman Metabolic Measurement Cart was used to determine the subjects' steady-state responses. Cardiac output was determined by the indirect CO₂ Fick method; mixed venous PCO₂ was calculated using the equilibrium CO₂ rebreathing method. No significant differences in central (HR, SV, Q) or peripheral (a-vO₂ diff) responses were found between the two submaximal exercise tests. Also, there were no significant differences in lactic acid (LA) and blood pressure responses. The results indicate that massage immediately prior to submaximal exercise at 80% intensity had no effect on the subjects' cardiovascular systems.*

One of the unresolved questions in athletics is the physiological benefits of massage, yet it is well accepted as an integral part of coaching and athletic conditioning. Athletes have come to accept massage as a way to improve performance. Physical therapists, orthopedists, and osteopaths use massage for rehabilitation (19) and to promote relaxation (9).

Many claims have been made for the use of massage, but few are based on controlled and carefully designed laboratory studies (4,5,16,21). For example, there seems to be some agreement that massage does not hasten nerve growth, remove subcutaneous fat, or increase muscle strength (6). Not surprisingly however, many athletes use massage to alleviate muscle cramps and remove lactic acid (14); increase pain threshold, flexibility, and coordination (11); stimulate circula-

tion and improve the transport of energy to muscles (15,17); and speed up healing and restoration of joint mobility (11). Unfortunately, the basis for prescribing massage relies solely on practical experience rather than scientific principles (2). The recuperative benefits may be more psychological than physiological.

Part of the difficulty in distinguishing psychological and physiological benefits lies with the lack of adequate scientific research to test various hypotheses. Therefore, athletes should probably be cautious of the various massage programs purportedly designed to enhance physical performance, and restore and/or maintain normal muscle function.

The purpose of this study was to determine whether the sports massage results in positive physiological responses during submaximal exercise, and whether the responses were caused by the central or peripheral adjustments.

METHODS

Ten healthy male volunteers (age = 28 ± 2.6 yrs, wt = 65.2 ± 9.2 kg) were studied. The procedure was fully explained, and informed consent was obtained prior to the study. This investigation was approved by the institution's Human Subjects Review Committee.

The subjects participated in both the Control Session (exercise without prior massage) and the Treatment Session (exercise with prior massage). The order of the sessions per subject was determined by a table of random numbers.

The submaximal exercise on the treadmill was designed to elicit 80% of the subjects' maximal heart rates. The following formula was used to determine the desired heart rate intensity: Exercise HR (bpm) = $220 - \text{age (years)}$. At "0" grade, the treadmill speed was increased per subject to approximate the desired heart rate response. The same exercise conditions were repeated during the second exercise test.

The sports massage therapist used alternating deep strokes and broad cross-fiber strokes of the lower extremities (i.e., the muscles were squeezed, compressed, and rolled) for a duration of 30 minutes. The therapist, an Australian trained masseur, worked with athletes who considered massage critical to their performance.

Oxygen consumption was determined every minute by

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the Beckman Metabolic Measurement Cart (MMC), which was calibrated by certified gas prior to exercise. Blood pressure was monitored by auscultation of the left brachial artery using a standard mercury manometer. Heart rate was derived from the electrocardiograph during the last 15 seconds of each minute of exercise. Cardiac output was estimated during the last minute of exercise using the MMC Clinical Exercise Testing Program. Arterial CO₂ (PaCO₂) was derived from the end-tidal PCO₂ (PETCO₂). Mixed venous PCO₂ (PvCO₂) was derived from the rebreathing procedure during which the subjects were disconnected from the non-breathing valve and connected to a bag filled with 11.75% CO₂ in oxygen. A Beckman MMC recorder was used to graphically examine the CO₂ signal generated during the rebreathing to ensure that a satisfactory PCO₂ equilibrium was achieved. Stroke volume was calculated by dividing cardiac output by heart rate. Arteriovenous oxygen difference was calculated by dividing oxygen consumption by cardiac output. Lactic acid was determined upon cessation of exercise using the spectrophotometric (Gilford Stasar III) technique (18).

RESULTS

Means and standard deviations were computed for all physiological responses (Table 1). Paired t-test indicated no significant differences ($p > .05$) between the Control Session exercise data (exercise without prior massage) and the Treatment Session exercise data (exercise with prior massage).

DISCUSSION

This study found that the sports massage did not result in an improved exercise performance, and that the subjects'

exercise oxygen consumption was derived from similar and peripheral adjustments. Both exercise tests at 80% of maximum heart rate required the same oxygen consumption (i.e., 3 L/min for the Control Session and 3.1 L/min for the Treatment Session). Therefore, the 30-minute massage just prior to exercise did not provide the subjects with increased oxygen flow to the body tissues. This finding is in contradiction to comments made by some sports massage enthusiasts (11). Without the massage, subjects exercised just as efficiently as when they had received the massage.

Oxygen consumption is the product of oxygen transport (i.e., $\dot{Q} = HR \times SV$) and oxygen utilization (i.e., $a-\bar{v}O_2$ difference). Improvement in a steady-state exercise oxygen consumption can be the result of either a change in oxygen transport or a change in oxygen utilization. A change in the transport of oxygen is generally characterized by a decrease in exercise heart rate, an increase in stroke volume, and no change in cardiac output. The decrease in heart rate at the same exercise cardiac output is indicative of a more efficient heart rate (1,7,10,12,13,20). However, this response did not occur. Heart rate was unchanged with massage. Also, there was no change in arteriovenous oxygen difference (which reflects the peripheral adjustment to maintaining exercise oxygen consumption). The subjects' oxygen utilization was the same with sports massage as without it.

The changes just described (but which did not occur in this study) allow for a more efficient physiological performance at the same oxygen consumption value. Therefore, had the changes occurred, the subjects would have been more physiologically efficient at the same energy expenditure.

It was also anticipated that the sports massage might result in a lower oxygen consumption response at the same exercise load. That is, it was thought that the subjects' exercise heart rate might decrease with no change in stroke volume (following the sports massage). The resultant effect would therefore be a smaller exercise cardiac output; the product of which would yield a smaller oxygen consumption, assuming that the extraction of oxygen in the periphery (i.e., oxygen utilization) was unchanged.

In this regard, several researchers (3,8) have shown that oxygen consumption is not constant. Benson et al. (3), for example, found that their subjects were able to lower steady-state exercise oxygen consumption by eliciting the relaxation response. Their results are interesting in that oxygen consumption during a fixed exercise bout was thought to be constant with each performance. One would expect that, had the sports massage helped the subjects in the present study, economically speaking, the metabolic cost of the exercise would have decreased. A finding of this type would be considered a positive influence of massage on performance (given that the subjects would recover faster).

It is also possible that an enhanced running economy is reflected in a decrease in lactic acid. This has led some researchers (14) to expect that massage prior to exercise affects the magnitude of the lactic acid response. It is very tempting to assume that with less lactic acid during exercise, the subjects would be able to exercise longer and recover faster. Again, a finding of this type would be considered a

Table 1. A physiological comparison of the Control (exercise without massage) and Treatment (exercise with massage) responses during 10 minutes of steady-state treadmill exercise (Mean and Standard Deviation)

Variables	Control	Treatment	t-ratio	Prob
$\dot{V}O_2$ (L/min)	3.0 ± .3	3.1 ± .4	.97	.62
\dot{Q} (L/min)	22.1 ± 3.1	22.0 ± 3.2	.05	.96
HR (bpm)	162.7 ± 9.5	159.3 ± 8.3	.96	.64
SV (ml)	135.2 ± 17.5	137.4 ± 21.3	.37	.72
a- $\bar{v}O_2$ diff (ml/100 ml)	13.1 ± 1.6	13.9 ± 1.3	.34	.74
SBP (mmHg)	166.6 ± 26.0	168.4 ± 24.3	.25	.80
DBP (mmHg)	79.2 ± 10.8	74.6 ± 9.0	-1.41	.19
LA (mM/L)	2.2 ± .8	2.0 ± .6	.78	.54

$\dot{V}O_2$ = oxygen consumption; \dot{Q} = cardiac output; HR = heart rate; SV = stroke volume; a- $\bar{v}O_2$ diff = arteriovenous oxygen difference; SBP = systolic blood pressure; DBP = diastolic blood pressure; LA = lactic acid; Non-significant ($p > 0.05$); paired t-test

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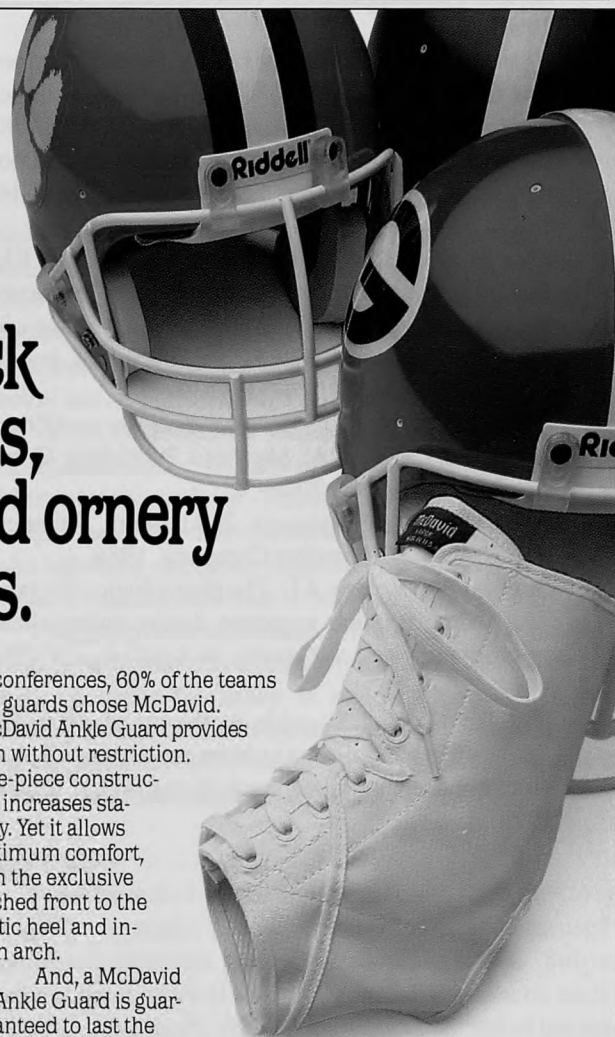
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positive reason for massage. However, our data indicated that the subjects' lactic acid responses following steady-state exercise were not significantly different. It appears justified to state that the physiological benefits of the sports massage are questionable.

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