Effect of Water Pressure on Selected Physiological and Psychological Responses to a 15-minute Aquamassage

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Introduction

Massage has been defined as a 'mechanical manipulation of body tissues with rhythmical pressure and stroking for the purpose of promoting health and well being' (Cafarelli and Flint, 1993 p17). Massage and other alternative therapy treatments are becoming increasingly popular to reduce tension, relieve muscle soreness and joint stiffness and mental and physical relaxation.

The therapeutic benefits of massage have been widely reported anecdotally, however few scientific studies are available to support this. This paucity of information may be a consequence of i) the inability to quantifiable measure aspects of the massage treatment and ii) the ability to clearly differentiate between physiological and psychological health benefits.

Within an investigation, a traditional massage treatment could vary in regard to massage pressure, massage speed, ambient temperature between masseurs where more than one masseur is used and where massages are performed on different days (Bale and James,1986; Hemmings et al, 2000; Mondero and Donne, 2000). Variability is also likely to occur within the same masseur particularly if they are required to perform repeated massages on the same day fatigue of the hands or upper body may invalidate the research protocol (Bale and James,1986; Hemmings et al, 2000; Mondero and Donne, 2000).

The measurement of physiological and psychological relaxation can also be difficult to quantify. Previous massage studies have considered the potential benefits of massage in a sporting environment as a recovery intervention particularly for the removal of lactic acid (Bale and James,1986; Hemmings et al, 2000; Mondero and Donne, 2000). Fewer studies have also considered the psychological benefits of massage (Boone et al, 1991; Hemmings et al, 2000; Weinberg et al, 1988) but their evidence of positive relationships appear to more conclusive than the physiological based studies. Weinberg et al (1988) reported a consistent relationship with massage and positive mood state and psychological well being in 183 physical education students. In particular, massage had a positive effect on tension, depression, anger, fatigue and confusion variables.

The Aqua massage unit has recently been introduced to the UK and claims to be a convenient way for people to gain the benefits of a traditional massage, hydrotherapy and heat therapy into one short alternative therapy session. Massage can be performed either to the front or the back of the body from three sides as a result of the thirty six water jets.The unit is highly sophisticated allowing variations in water temperature (30°C - 40°C), water jet pressure (1.5 lbs – 12 lbs) and the horizontal travel speed of the water jets ($0.05\ m.s^{-1} - 0.11\ m.s^{-1}$). Additionally it is also possible to change the pulsing frequency of the water jets to allow simulation of traditional effleurage, wringing and hacking techniques. Therefore, as a research tool, the Aqua massage can be easily programmed to perform a traditional massage routine,

whilst providing reliability of massage pressure, speed and ambient temperature.

The Aquamassage may be of benefit in corporate health programmes particularly in the management of stress and lower back injury. Research has not yet been undertaken to consider the relative benefits of the different water pressures and temperatures on the overall massage effect. Massage may promote deep relaxation which in a corporate setting may have a negative effect on subsequent work productivity. Deep massage may cause additional muscle damage which may promote discomfort an/or injury in sedentary and less active populations. Consequently this research study was designed to investigate the effects of no massage and massage at three different water pressure (3, 6 and 9 lbs) on heart rate and mood states of University administrative and support workers.

Method

Thirty-one administrative and support staff (mean ± sd: age = 43.4 ± 13.5 years, height = 165.9 ± 7.6 cm and weight = 74.4 ± 14.8 kg) from the University of Wolverhampton volunteered to participate in the investigation.

Participants visited the Human Performance Centre on five occasions. On the first occasion they each completed a medical history questionnaire and informed consent form and were assessed for height (stadiometer, Bodycare UK) and weight (Seca) before undertaking a 10-minute familiarisation massage. The remaining four sessions were the experimental trials where a 15-minute massage was undertaken at 3, 6 and 9 lbs of water pressure at a constant temperature of 35°C. As a control, participants lay in the Aquamassage unit for 15 minutes but received no massage whilst body position and ambient temperature were identical to previous trials. The order of the four trials was randomised – 24 different connotations and participants were randomly assigned to one of these sequences whilst ensuring that at least one participant was allocated to each of the orders and no more than two received the same order of trials. Trials for each participant were completed at the same time of day with a minimum of 48 hours between trials.

The 15-minute massage sequence was designed to mimic as closely as possible a traditional massage by varying the frequency of the water jets to simulate effleurage (low), wringing (moderate) and hacking (high) motions and is detailed in table 1. The speed of the travel arm was constant at 0.05m/s^{-1}.

Participants completed a 32-point mood state questionnaire (Brunel Scale) immediately before, immediately after and 1 hour after the massage to identify if changing the water pressure altered mood state changes. Additionally, participants wore a heart rate monitor (S610 Polar, Kempele, Finland) throughout the massage. Participants wore ear defenders during each trial to reduce the noise of the water jets and also to promote relaxation by minimising environmental noise.

Table 1: 15-minute massage sequence

Time	Direction	Pulsator Action	Body Area
15:00	Single	Low	Full
13:00	Double	Low	Full
11:00	Single	Moderate	Shoulder/Back
9:30	Double	Moderate	Shoulder/Back
8:00	Double	High	Shoulder/Back
7:00	Double	Moderate	Shoulder/Back
5:30	Single	Moderate	Shoulder/Back
4:00	Double	Low	Full
2:00	Single	Low	Full
0:00	-	-	-

Group mean heart rate for each of the 15 minutes was calculated and a repeated measures ANOVA was performed to identify if there were any significant differences between the heart rate response to each of the trials. Group mean mood scores for each of the different mood components was calculated pre, post and 1-hour post each of the four trials.

Results and Discussion

Mood States

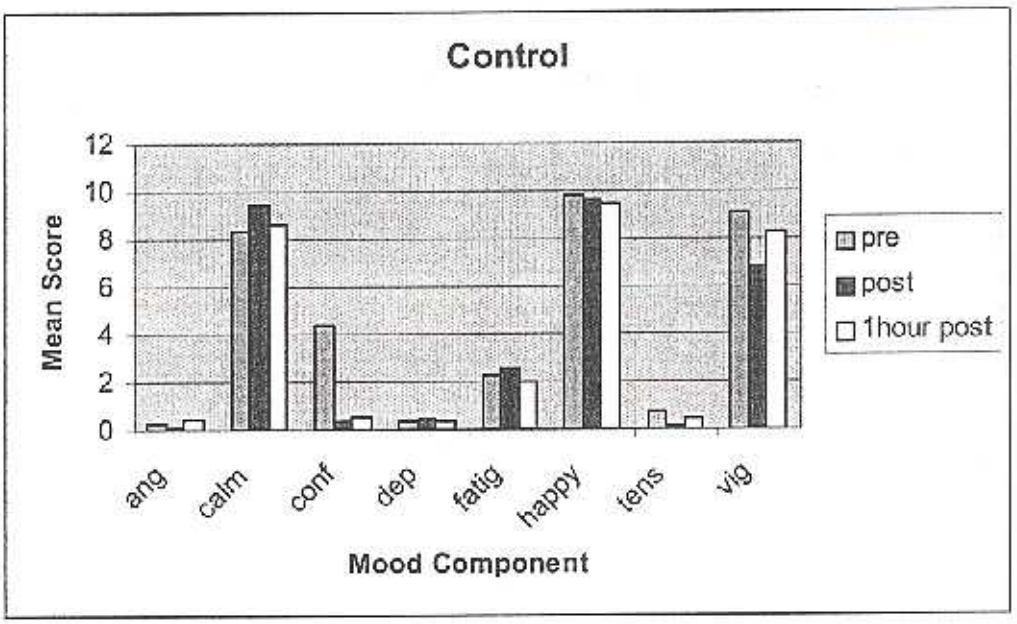
The participants mood was measured immediately before, immediately after, and one hour after four trials; a control trial involving lying in the aqua massage unit without receiving a massage, a 3lbs water pressure massage, a 6lbs water pressure massage, and a 9lbs water pressure massage. The participants mean score was calculated for each mood component (anger, calm, confusion, depression, fatigue, happiness, tension, and vigour).

The results of the control condition are presented in Table 1 and Graph 1.

Table 1. Mean mood scores pre, immediately post and 1-hour post control condition.

	pre	post	1hour post
anger	0.23	0.10	0.43
calm	8.40	9.47	8.63
confusion	4.33	0.40	0.57
depression	0.33	0.47	0.33
fatigue	2.30	2.53	2.03
happy	9.83	9.67	9.47
tension	0.73	0.17	0.50
vigour	9.07	6.80	8.30

Graph 1. Mean mood scores pre, immediately post and 1-hour post control



Lying in the aqua massage unit, without receiving a massage, had a mixture of both positive and negative effects on participants' mood.

Immediately following the control condition, participants reported positive mood benefits, through a slight decrease in levels of anger and tension, and through a large decrease in levels of confusion. Participants also reported feeling more calm.

Lying in the aqua massage unit also had a negative effect on aspects of the participants' mood. Specifically, participants experienced a small increase in depression and fatigue and a small decrease in happiness. Participants were also considerably less vigorous following the massage.

One hour later, participants were still feeling slightly less tense, were more calm, and considerably less confused, however felt slightly more angry than they had prior to lying in the aqua massage unit.

Participants were fractionally less depressed one hour later than they had been prior to lying in the aqua massage unit, however were still experiencing slightly lower levels of happiness.

Although participants mean score for vigour remained lower than the pre condition score, one-hour later levels of fatigue had decreased to a level below that reported pre massage.

Participants may have felt less angry and tense, and more calm after lying in the aqua massage unit as this provided them with an opportunity to take time out from their usual schedule and relax. Being in a more relaxed state would

also explain why the participants reported feeling more fatigued and less vigorous after lying in the aqua massage unit.

The large decrease in confusion following the control condition may be the result of the participants' high levels of confusion prior to the trial. It is possible that the participants did not understand the point of lying in an aqua massage machine without receiving a massage. If participants felt more relaxed after the massage they would more clearly understand that the aqua massage unit could promote positive mood changes without administering a massage. This may have resulted in the observed decrease in confusion.

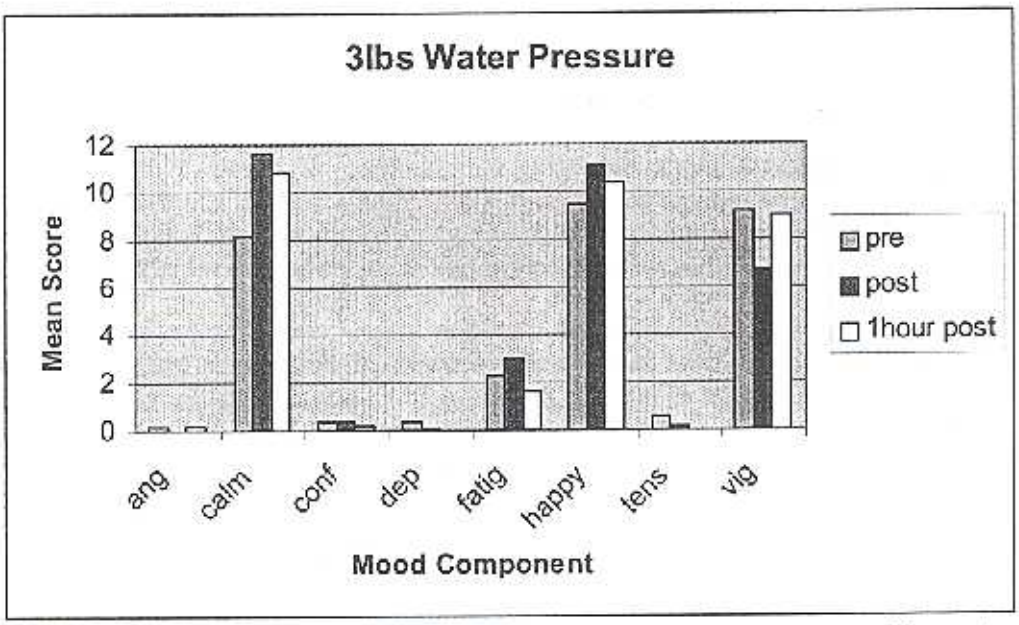
The participants increased level of depression, and decreased level of happiness could be due to various reasons. Participants may not have enjoyed the experience of lying in the aqua massage unit without receiving a massage, and this in turn had a negative effect on their mood. It is also possible however that the time spent in the aqua massage unit provided an opportunity to reflect on negative experiences, for example the events of a bad day at work.

Lying in the aqua massage unit lowered the participants' levels of anger. Therefore the observed increase in anger one-hour later is most likely due to intervening events.

The results of the 3lbs-massage condition are presented in Table 2 and Graph 2.

Table 2. Mean mood scores pre, immediately post and 1-hour post 3lbs water pressure massage.

	pre	post	1hour post
anger	0.20	0.00	0.19
calm	8.17	11.63	10.78
confusion	0.33	0.40	0.15
depression	0.40	0.13	0.00
fatigue	2.23	3.03	1.63
happy	9.43	11.07	10.33
tension	0.57	0.20	0.04
vigour	9.20	6.70	9.04



Graph 2. Mean mood scores pre, immediately post and 1-hour post 3lbs water pressure massage.

Following the 3lbs water pressure massage, participants reported slightly less anger, depression, and tension than they had prior to the massage. The participants also reported reasonably large increases in levels of calm and happiness. These positive mood benefits were still present 1 hour after the massage.

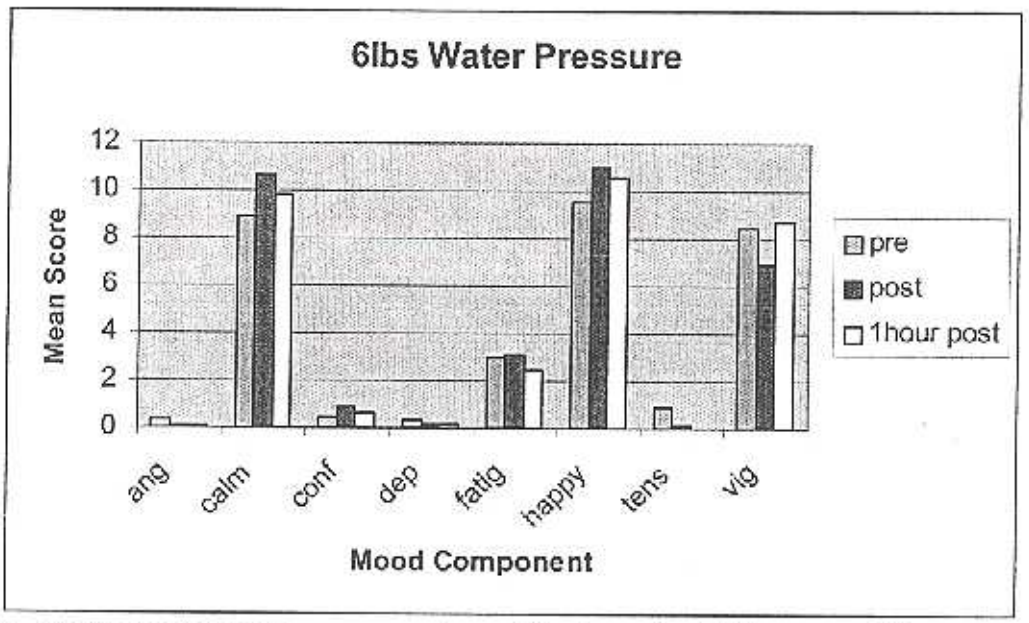
Although participants reported an immediate increase in fatigue and a also a small increase in confusion, one-hour post the 3lbs water-pressure massage, participants were less fatigued and less confused than they were prior to the massage.

Participants reported feeling less vigorous after the 3lbs massage than they had prior to the massage. One hour later the participants' vigour was still lower than it had been prior to the massage.

The results of the 6lbs-massage condition are presented in Table 3 and Graph 3.

Table 3. Mean mood scores pre, immediately post and 1-hour post 6lbs water pressure massage.

	pre	post	1hour post
anger	0.39	0.07	0.09
calm	8.89	10.67	9.86
confusion	0.50	0.89	0.64
depression	0.32	0.15	0.14
fatigue	3.04	3.11	2.41
happy	9.57	11.04	10.59
tension	0.89	0.22	0.05
vigour	8.50	6.93	8.73



Graph 3. Mean mood scores pre, immediately post and 1-hour post 6lbs water pressure massage.

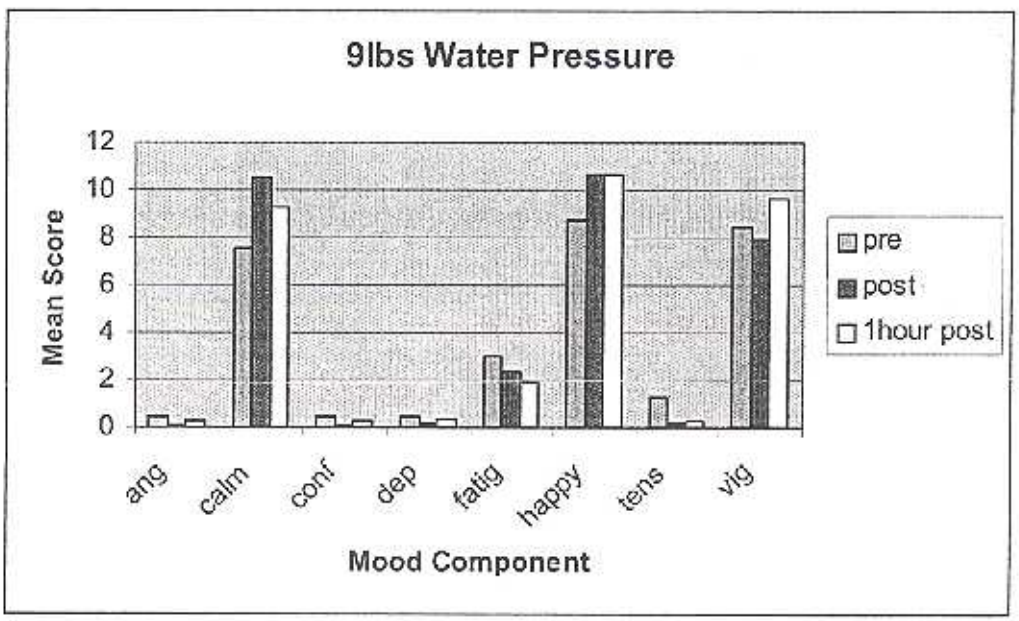
Immediately following the 6lbs water pressure massage, participants reported small reductions in levels of anger, depression, and tension. Participants also reported enhanced levels of calm and happiness. These positive mood benefits were accompanied by a small increase in confusion. These changes in mood were still present 1 hour after the massage.

Participants felt less vigorous and slightly more fatigued immediately after the 6lbs water-pressure massage than they had before the massage. One hour later, however, participants reported feeling more vigorous and less fatigued than they had prior to the massage.

The results of the 9lbs-massage condition are presented in Table 4 and Graph 4.

Table 4. Mean mood scores pre, immediately post and 1-hour post 9lbs water pressure massage.

	pre	post	1hour post
anger	0.48	0.07	0.23
calm	7.52	10.55	9.31
confusion	0.45	0.10	0.27
depression	0.45	0.17	0.37
fatigue	2.97	2.38	1.88
happy	8.69	10.66	10.65
tension	1.31	0.17	0.31
vigour	8.48	7.93	9.62



Graph 4. Mean mood scores pre, immediately post and 1-hour post 9lbs water pressure massage.

Immediately following the 9lbs water pressure massage, participants reported lower levels of anger, confusion, depression, fatigue, and tension, as well as higher levels of calm, and happiness than they had prior to the massage. These positive mood benefits were still present 1 hour after the massage.

Although participants experienced an immediate decrease in vigour following the 9lbs massage, one-hour later participants reported greater levels of vigour than they had pre massage.

In summary, all massage conditions were effective at immediately reducing feelings of anger, depression and tension and all massage conditions resulted in an increase in feelings of calm and happiness.

Therefore 3lbs, 6lbs, and 9lbs intensity of massage are effective at improving mood. These positive mood benefits were still present 1 hour after the massage.

The decrease in participants' anger, depression, and tension is likely due to the fact that the massage had provided them with time to relax. This would also explain the observed increase in feelings of calm and happiness.

The 3lbs water pressure massage resulted in the greatest increase in fatigue and calm. Following the 3lbs massage, participants reported feeling more restful, composed, sleepy and tired, suggesting this massage was the most relaxing.

The 9lbs water pressure massage was the only massage to result in an immediate decrease in fatigue. This decrease was still present 1 hour later. Although participants reported feeling slightly less vigorous immediately following the 9lbs massage, one-hour later participants reported greater levels of vigour than they had prior to the massage. This research suggests that intense (9lbs) massage is the most effective at enhancing feelings of invigoration.

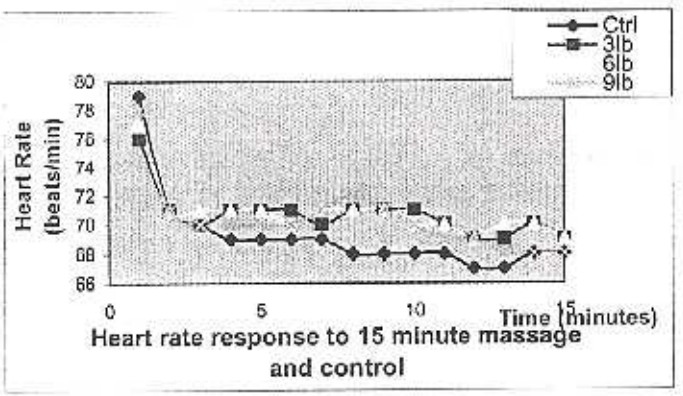
Heart rate

For all trials heart rate rapidly decreased in the first two minutes and then remained reasonably constant or decreased slightly for the remaining 13 minutes. There was no significant difference in heart rate response for each of the four trials ($P > 0.05$), although the heart rate in the control trial appeared to be the lowest throughout (Table 5 and Graph 5)

Table 5: Mean (± sd) heart rate (beats/min) at minutes 1, 5, 10 and 15

Trial	Minute 1	Minute 5	Minute 10	Minute 15
Control	79 (± 12)	69 (± 12)	68 (± 11)	68 (± 11)
3 lb	76 (± 14)	71 (± 12)	71 (± 12)	69 (± 12)
6 lb	77 (± 12)	71 (± 12)	69 (± 11)	70 (± 12)
9 lb	78 (± 12)	70 (± 11)	70 (± 11)	68 (± 11)

If heart rate is interpreted as an indicator of physiological relaxation, the results indicate that in all trials, participants were equally relaxed and therefore a 15-minute aqua massage is of benefit regardless of water pressure in administrative and support workers.



Heart rate response to 15 minute massage and control

Conclusion

From a physiological perspective the selection of water pressure should be what the participant perceives to be as the most comfortable, however the heart rate response must be considered in association with the mood state responses. Consequently since the physiological response does not differ with water pressure, the selection of water pressure should be determined in light of the mood state responses.

With regard to mood, all massage conditions were effective at immediately reducing feelings of anger, depression and tension and all massage conditions resulted in an increase in feelings of calm and happiness.

Therefore 3lbs, 6lbs, and 9lbs intensity of massage are effective at improving mood. These positive mood benefits were still present 1 hour after the massage.

Finally, a water pressure of 3lbs should be selected by participants undertaking a massage for relaxation purposes and a water pressure of 9 lbs should be selected for those looking for an invigorating effect.

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