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The Effects of Classical Massage on Blood Pressure, Oxygen Saturation, Respiratory and Resting Heart Rates in Blind Men

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Abstract: The aim of this study was to determine the effects of classical massage (four days a week-one hour a day) on systolic and diastolic blood pressures, oxygen saturation, respiratory and resting heart rates. Twenty volunteered blind men participated in this study. Mean age, body weight and height of the subjects were 30.75±6.39 years, 75.00±9.23 kg and 176.30±8.27 cm., respectively. All the outcome measurements (blood pressure, oxygen saturation, respiration and resting heart rate) were taken twice one hour before and one hour after the massage. The anthropometric parameters such as body weight, height, skinfold thicknesses (triceps, biceps, subscapula, suprailiac, abdominal, thigh) were measured and body mass index and body fat percentage were calculated. In order to perform pre- and post-massage analysis, paired samples -t- test was used to determine the inter-group difference. The intra-group difference was determined by One Way Repeated Measures Analysis of Variance (post - hoc Bonferroni t-test). The significance was set at $p<0.05$. The classical massage applied to whole body induced significant decrements in systolic and diastolic blood pressures, respiratory and resting heart rates and significant increments in oxygen saturation. In conclusion, the classical massage applied to whole body had positive effects on circulatory and respiratory systems and also on Oxygen saturation. This application 2-3 times weekly may increase the quality of life of the individuals.

Key words: Blind men · Classical massage · Circulatory · Oxygen saturation · Respiration · Heart rate

INTRODUCTION

Massage therapy is an ancient therapeutic technique that has been used in most civilizations. Classical massage therapy has a history of 5000 years and it has been known since ancient Indians, Greeks, Chinese and Egyptians. It continues to be recognized as a beneficial healing art that provides comfort as well as a technique that helps reduce pain, anxiety and tension. Today, massage is widely used throughout the world. The origin of the word massage stem from "mass" meaning touch in Arabic and "massein" meaning knead in Greek. There are a number of definitions for massage. For instance, forming physiological and psychological effects on the organism by systemic manipulations which stimulates soft tissues, might be one. Massage has a common purpose which helps the individual to feel both physiological and psychological relief. Massage can be applied both by hands or using some instruments. However, manual massage constitutes the main basic form. Classical massage can be divided into five parts as stroke (efflurage), knead (petrisage/wringing), friction, percussion (tapotement) and vibration, respectively [1-3].

It has been estimated that 36-42% of the US population use complementary alternative medicine (CAM) modalities, with 5-11% specifically seeking massage therapy. While reasons for seeking massage therapy are diverse, visits are frequently related to stress reduction. For example, wellness care (relaxation) accounted for 19% and anxiety reduction 5-9% of total visits to massage therapists [4].

The stress response is the body's reaction to any real or perceived threat and activates the sympathetic branch of the autonomic nervous system resulting in stimulation of the hypothalamus-pituitary-adrenal (HPA) axis. This mechanism of action will increase heart rate and mobilize fuel stores in preparation for the perceived threat. In contrast, massage therapy is believed to stimulate the parasympathetic branch of the autonomic nervous system. Activation of the parasympathetic nervous system facilitates the return to homeostasis after an emergency by reversing some of the physiological systems activated during the stress response. For example, an increase in parasympathetic tone would reduce heart rate and slow respiration, resulting in relaxation [4].

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Massage therapy is a systematic and scientific manipulation of soft tissues of the body. Massage therapy has been extensively documented as one of the oldest therapeutic approaches used to reduce pain, anxiety/disturbed mood, agitation, physiological arousal, sleep disruption and muscle tension. Other benefits included improvement of local circulation, lymph flow, fatigue and immunity [5]. The physiologic effects of massage therapy include decreased systolic blood pressure, diastolic blood pressure and heart and respiratory rates in hypertensive, cancer and hospice patients as well as patients after coronary artery bypass grafting and also increase peripheral skin temperatures by virtue of physical pressure and heart stimuli [6, 7]. As the massage therapy is the manipulation of soft tissues for the purpose of producing physiological effects on the vascular, muscular or nervous systems of the body it has been reported that the effect of massage therapy is more robust when administered by trained therapists [4].

Traditional vital signs include body temperature, heart rate, respiration and blood pressure. In recent years, oxygen saturation is also added to these four components [8, 9]. In the last decade, pulse oximetry use in emergency settings became popular as sfigmomanometers [10,11]. In modern medicine, pulse oximetry is a non-invasive vehicle to measure oxygen saturation which does not need any calibration [9, 10, 12, 13]. Pulse oximetry determines the percent of oxygenated hemoglobin in arterial blood and the result is known as oxygen saturation [14].

Pulse oximetry, as its name suggests, measures and is dependent on two components. The first is the generation of an arterial pulsatile signal and the second is the differing absorption spectra of oxyhaemoglobin and deoxyhaemoglobin which are used to calculate oxygen saturation. Whereas oxyhaemoglobin and deoxyhaemoglobin absorb light over a range of wavelengths their absorption spectra peak at 660 nm [red light] and 940 nm (infrared), respectively. A photoreceptor placed on the opposite side to the LEDs records the transmitted light and generates the sensor signal output. The tissue to be measured is placed between the LEDs and photoreceptor, usually a finger or ear. The signal processor compares the ratio of absorption of the two spectra against a stored set of reference values. These reference values are compiled by volunteer desaturation studies where both the absorption spectra ratios and direct arterial oxygen content are measured [15].

The current study aimed to determine the effects of classical massage (4 days weekly-one hour) on respiratory and resting heart rate, systolic and diastolic blood pressure and oxygen saturation.

MATERIALS AND METHODS

Participants: The current study included 20 volunteered blind men. Mean age, body weight and height of the subjects were 30.75±6.39 years, 75.00±9.23 kg and 176.30±8.27 cm, respectively. The blind men were preferred because of their stable physical activity as they use the same way (route) everyday.

Classical Massage Therapy Procedure: The massage was applied to the following body parts: back, legs, abdomen, chest and arms.

Massage therapy (temporal sequence and stroke technique)

Procedural Steps:

- Visit the individual at mid-day (between 1 and 5 pm) at massage room.
- Close door of room and draw curtains.
- Decrease external noise.
- Massage extremities for 20 minutes.
- Each leg for 5 minutes (10 minutes total).
- Each arm for 5 minutes (10 minutes total).
- Turn the individual laterally onto left side when performing back massage. Encourage him to get comfortable in this position without seeking support.
- Massage back (sacral through to cervical area) for 10 minutes.

Primary Stroke:

- Effleurage[1]: The spectrum of this stroke can be determined by pressure, drag, speed and direction
- Pressure: light (less than the pressure of the hand) to medium (heavy enough to affect the underlying tissues but not to press through the bone).
- Drag: Minimum on dermal layer; use hypoallergenic oil or lotion as lubricant on skin.
- Speed: Use an effleurage rate of 10 to 12 inches/second.

[1]Effleurage (deep or gentle stroking), pe´ trissage (kneading or wringing) and friction (strong circular pressure on one point) are basic techniques. They can be applied to diffusely innervated areas of the body that are available to a massage therapist such as the scalp, back and outside areas of limbs (including hands and feet).

Direction:

- Always in the direction of venous flow, eg, rub extremities toward the torso.

Outcome Measures: One hour before and one hour after the classical massage; respiratory and resting heart rates, systolic and diastolic blood pressure and oxygen saturation were measured twice. Thus, four measurement values are included for the variables in Table 2.

Respiratory Rate (Rate per Minute-rpm): The researcher recorded the respiratory rate per minute (rpm) by counting the subjects' inspirations and expirations through the movements of the thorax/abdomen, for a full minute using a stopwatch.

Resting Heart Rate (Beat per Minute-bpm): Resting heart rate were measured in a resting state with the proper equipment (Microlife BP 3 AS). Three measurements were taken and the average was recorded.

Systolic and Diastolic Blood Pressures (mmHg): Two consecutive measurements of blood pressure were taken on the right arm two-three minutes apart with the subject being seated at least 10 minutes by the researcher. Systolic blood pressure was first checked by palpation prior to the auscultatory measurements. Systolic and diastolic blood phase V pressures were recorded to the nearest two mmHg. Normal mercury sphigmomanometers (Boehringer-Mannheim, Germany) were used with standard sized cuffs. Blood pressures were measured twice for each participant and the average was used for subsequent analysis.

Oxygen Saturation (%): Pulse oximetry (Nellcor Puritan Bennet NPB-40) was used. To measure oxygen saturation, the pulse oximeter probe is attached to the patient's finger. Red and infrared light pass through the patient's blood and the amount of light received by the detector on the other side indicates the amount of oxygen that is bound to the hemoglobin. (Oxygen attaches to the heme portion of hemoglobin molecules in the red blood cells. Each hemoglobin molecule can carry up to four oxygen molecules) Oxygenated hemoglobin (oxyhemoglobin, or HbO_2) absorbs more infrared light than red light, while deoxygenated hemoglobin (Hb) absorbs more red light than infrared light. By comparing the amounts of red and infrared light received, the instrument can calculate the oxygen saturation (16). The light source of the oximetry was placed on the left hand's index finger (while placing the probe on the finger, the nail was carefully investigated for the presence of any layer). The massage room was used for measurements. Prior to the measurement, the researcher explained the aim of this procedure and gave some details to the participants and also the questions of the participants were answered. The researcher firstly put the probe on the participant's finger and told the process will not give any pain or ache and relaxed them. Then, three measurements were taken and the average was recorded.

Body Weight and Height: Body height and weight were measured using a calibrated scale. Height was measured to the nearest 0.5 cm and weight to the nearest 0.1 kg and. Weight was measured to 0.1 kg using a standard beam balance using a Tefal Ultraslim (France) accuracy, in minimal clothing (bare feet and with light clothing). Height was determined to the nearest 1 mm with portable stadiometers. The portable scales and stadiometers were calibrated daily. BMI (kg/m^2) was calculated from body weight and height [17].

Skinfold Thicknesses and Body Fat Percentage (%): Skinfold thicknesses were measured from biceps, triceps, subscapula, suprailiac, abdomen and thigh in accordance with the procedure by a skinfold caliper. All the measurements were taken twice and the average was recorded. Body fat percentage (%) was calculated according to Green formulae (Body fat %= 3.64+ sum of skinfolds x 0.097) [18].

Statistical Analyses: The obtained data was processed by SPSS (Statistical Package for the Social Sciences) 15.0. Measurement results were presented as the mean and standard deviation ($\bar{x} \pm SD$). In order to perform pre- and post-massage analysis, paired samples -t- test was used to determine the inter-group difference. The intra-group difference was determined by One Way Repeated Measures Analysis of Variance (post-hoc Bonferroni t-test). The significance was set at $p<0.05$.

RESULTS

The anthropometric variables of the participants are demonstrated in Table 1. Mean systolic blood pressure was 119.30±10.35 mmHg in the first pre-massage measurement and it increased to 125.35±4.90 mmHg in the fourth pre-massage measurement ($p<0.001$), while it was measured as 112.00±6.15 mmHg in the first post-massage and it increased to 115.25±5.20 in the fourth post-massage measurement ($p<0.002$) (Table 2).

Table 1: Anthropometric indices of the participants (n=20)

Variables	x̄±SD	Maximum	Minimum
Age (year)	30.75±6.39	43.00	22.00
Height (cm)	176.30±8.27	190.00	164.00
Body weight (kg)	75.00±9.23	90.00	61.00
Body mass index (kg/m^2)	24.10±3.01	29.00	19.70
Body fat percentage (%)	10.97±2.03	14.20	7.10
Skinfold thicknesses (mm)			
Biceps	4.48±1.56	8.00	3.00
Triceps	8.52±3.02	13.00	4.00
Subscapular	12.35±3.31	20.00	8.20
Suprailiac	16.21±5.90	28.00	6.30
Abdominal	20.41±6.07	32.00	7.20
Quadriceps femoris	12.96±5.02	21.00	6.10

Table 2: The pre-massage and post-massage measurements of systolic and diastolic blood pressure, resting heart rate, respiratory rate and oxygen saturation of the participants (n=20)

	Measurements		
Variables	Pre-massage x̄±SD	Post-massage x̄±SD	P (intra-group)
Systolic blood pressure (mmHg)			
Systolic BP 1.	119.30±10.35	112.00±6.15	<0.001
Systolic BP 2.	125.20±5.46	117.00±4.70	<0.001
Systolic BP 3.	118.60±8.67	112.50±6.38	<0.001
Systolic BP 4.	125.35±4.90	115.25±5.20	<0.001
P (inter-group)	<0.001	<0.001	
Diastolic blood pressure (mmHg)			
Diastolic BP 1.	89.70±11.88	77.00±11.86	<0.001
Diastolic BP 2.	76.00±11.36	72.70±9.83	<0.001
Diastolic BP 3	87.05±12.27	76.45±9.70	<0.001
Diastolic BP 4.	76.15±10.51	70.65±8.06	<0.001
P (inter-group)	<0.001	<0.001	
Resting heart rate (pulse/min)			
RHR 1.	74.10±10.03	73.80±7.91	=0.889
RHR 2.	85.00±10.50	75.90±8.47	<0.001
RHR 3.	74.70±9.35	73.15±6.81	=0.443
RHR 4.	83.20 ±8.90	75.90±8.47	<0.001
P (inter-group)	<0.001	=0.168	
Respiratory rate (beat/min)			
RF 1.	22.65±2.97	19.10±2.10	<0.001
RF 2.	22.70±2.13	16.35±1.97	<0.001
RF 3.	20.65±1.94	15.40±2.08	<0.001
RF 4.	19.80±1.39	15.16±1.67	<0.001
P (inter-group)	<0.001	<0.001	
Oxygen saturation (%)			
OS 1.	95.50±1.39	97.20±0.89	<0.001
OS 2.	95.70±1.12	97.10±0.85	<0.001
OS 3.	95.35±1.13	97.15±0.81	<0.001
OS 4.	95.75±1.02	97.35±0.81	<0.001
P (inter-group)	=0.438	=0.704	

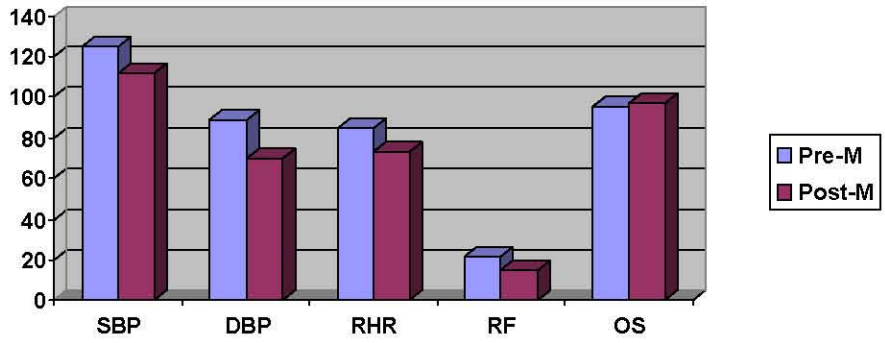

Fig. 1: The pre-massage (Pre-M) and post-massage (Post-M) measurements of systolic and diastolic blood pressure (SBP, DBP) resting heart rate (RHR), respiratory rate (RF) and oxygen saturation (OS) of the participants (n=20)

Mean diastolic blood pressure was 89.70±11.88 mmHg in the first pre-massage measurement and it decreased to 76.15±10.51 mmHg in the fourth pre-massage measurement ($p<0.001$), while it was measured as 77.00±11.86 mmHg in the first post-massage measurement and it decreased to 70.65±8.06 mmHg in the fourth post-massage measurement ($p<0.001$). The decrements in systolic and diastolic blood pressures for pre- and post-massage period were significant ($p<0.001$). Intra-group difference was also significant ($p<0.001$) (Table 2). Mean resting heart rate was 74.10±10.03 pulse/min in the first pre-massage measurement and it increased to 83.20±8.90 pulse/min in the fourth pre-massage measurement ($p<0.001$), while it was measured as 73.80±7.91 pulse/min in the first post-massage measurement and it increased to 75.90±8.47 pulse/min in the fourth post-massage measurement ($p=0.168$). The decrements in resting heart rate 2 and 4 for pre- and post-massage period was significant ($p<0.001$). Pre-massage values induced significant changes ($p<0.001$) (Table 2). Mean respiratory rate was 22.65±2.97 beat/min in the first pre-massage measurement and it decreased to 19.80±1.39 beat/min in the fourth pre-massage measurement ($p<0.001$), while it was measured as 19.10±2.10 beat/min in the first post-massage measurement and it decreased to 15.16±1.67 beat/min in the fourth post-massage measurement ($p<0.001$). The decrements in respiratory rate for pre- and post-massage period was significant. Intra-group difference was also significant ($p<0.001$) (Table 2). Mean oxygen saturation was 95.50±1.39% in the first pre-massage measurement and it increased to 95.75±1.02% in the fourth pre-massage measurement ($p=0.438$), while it was measured as 97.20±0.89% in the first post-massage measurement and it increased to 97.35±0.81% in the fourth post-massage measurement ($p=0.704$). The increments in oxygen saturation for pre- and post-massage period was significant ($p<0.001$). Intra-group difference was non-significant (Table 2).

DISCUSSION

To the best of knowledge, the current study is the first one including blind men to have a regular classical massage for the first time. In the current literature, massage sessions were supplied to hospitalized patients for several diseases or to premature infants. There are scarce studies conducted with healthy individuals, thus chose a disadvantaged group of men and determined the effects of classical massage therapy (four days weekly-one hour a day) on systolic and diastolic blood pressure, respiratory and resting heart rates and oxygen saturation. In the current study, detected significant decrements in systolic and diastolic pressures, respiratory and resting heart rates, along with significant increments in oxygen saturation.

Increases in blood pressure, respiration and heart rate are all physiological manifestations of the sympathetic nervous system's response to stressful events. Stressful experiences in the workplace, for example, can raise blood pressure and heart rate, which could subsequently contribute to cardiovascular disease. One argument is that massage therapy may ameliorate these symptoms of stress by promoting parasympathetic activity [4]. A 10 minutes back massage (three times a week for 10 sessions) induced significant changes in both systolic and diastolic blood pressures of individuals clinically diagnosed with hypertension. The effect size was 2.25 mmHg for systolic and 1.56 mmHg for diastolic blood pressure [19]. Kaye *et al.* [20] reported significant reductions in systolic and diastolic blood pressures of 263 volunteers given deep tissue massage for 45 and 60 minutes. The effect size was 10.4 mmHg for systolic and

5.3 mmHg for diastolic blood pressure with the mean arterial pressure reduction of 7.0 mmHg. Jerrilyn *et al.* [21] aimed to determine the change in blood pressure in normotensive and prehypertensive adults receiving a therapeutic massage. Systolic blood pressure decreased by 1.8 mmHg and diastolic blood pressure increased by 0.1 mmHg. Type of massage was found to be the main factor affecting change in blood pressure. The variability in outcome measures may result from the limited number of subjects included in most previous studies along with a lack of clearly defined form of massage used. The massage applied after physical activity lead a decrease in heart rate [22] and systolic blood pressure [23]. Kaya [23], reported significant decreases in heart rate and systolic blood pressure while non-significant decrease in diastolic blood pressure after massage. Results are in accordance with his study. Similarly, Celik and Aksoy [24], found an increase in oxygen saturation, heart rate and systolic blood pressure and a decrease in diastolic blood pressure after back massage. On the contrary, Tyler *et al.* [25] found an increase in heart rate in patients after back massage. Aourell *et al.* [26] reported a direct decrease in systolic blood pressure after each treatment with Swedish massage on back, chest and neck or legs, arms and face. However, a decrease in diastolic blood pressure was not seen until after 6 weeks of consecutive massage treatment. The effects of massage on blood pressure may have both physiological and psychological factors.

The preliminary findings suggest that a single 20 min massage therapy session is effective in reducing transient anxiety and stress levels in psychiatric inpatients. Following the initial and final massage therapy session there was a significant reduction in self-reported anxiety, resting heart rate and cortisol levels [27]. A 5-min foot massage administered to critical care patients effected a statistically significant decrease in heart rate from 97.3 to 94.7 beat per minute (bpm) during the massage, however, the reduction was not maintained when assessed 5 min post-massage [28]. Cowen *et al.* [29] found that a single 90-min Thai or Swedish massage significantly reduced heart rate among healthy subjects when assessed upon massage therapy completion ([69.0 bpm to 63.4 bpm). Ejindu [30], reported a drop of 3 bpm in mean pulse rate and a drop of 1 bpm in mean heart rates of 6 healthy female volunteers given 20 min foot and 20 min facial massage. Kaye *et al.* [20] also reported a significant decrease in heart rate [reduction of 10.8 bpm] with deep-tissue massage. Yet, the benefit may be repeatable as heart rate was reported to be reduced at each of six massage sessions for migraine sufferers, although the effect did not carry over to following sessions [31]. In addition, a massage session that focused on myofascial trigger point therapy significantly reduced heart rate immediately after massage therapy [32]. The authors also reported evidence indicating an increase in heart rate variability, which suggests the mechanism for reducing heart rate is by increasing parasympathetic activity.

On the contrary, in the current study, detected a significant increase in the pre-massage period and a non-significant increase in resting heart rates in the post-massage period. While individual effects on heart rate may vary, collectively, a small decrease in resting heart rate is frequently observed immediately following massage therapy and the duration of the massage does not appear to be a critical variable. Yet, the effect does not persist as heart rate measurements taken just minutes following massage therapy have been reported to return to pre-massage values.

Celik and Aksoy [24], reported a significant increase in arterial oxygen saturation in right lateral position after 1-min back massage in 30 critical care patients. Beeken *et al.* [32] reported significant changes in heart rate and oxygen saturation of patients with chronic obstructive lung disease receiving neuromuscular release massage therapy. In accordance with these studies, we detected significant increases in the post-massage period when compared to pre-massage values.

CONCLUSION

Classical massage applied to whole body induced a decrement in respiratory and resting heart rates, systolic and diastolic blood pressures; an increment in oxygen saturation. As the classical massage applied to back, lower extremities, abdomen and upper extremities positively affected respiratory system, in order to increase the life quality and to relieve the daily stress and fatigue a classical massage for three days weekly is recommended.

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