Psychophysiological effects of slow stroke back massage in normotensive females

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MASSAGE, THE manipulation of soft tissue for therapeutic purposes, is an ancient art. There are many different types of massage strokes and sequences for stroking, and these are described in any physical therapy text. The effects of massage have been classified as psychological, mechanical, physiological, and reflexive, depending on the type of stroking employed.[1] Nurses have traditionally used the back massage or back rub as a relaxation technique to promote sleep, presumably by inducing muscle relaxation. A traditional back massage, as described by Michelson,[2] includes effleurage, petrissage, and kneading. It provides passive exercise, prevents depressed circulation and tissue breakdown, aids natural skin tone, and relieves tension.[3]

The effects of traditional back massage have not been extensively documented in

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the literature. Studies of the back massage show no consistent, predictable effects. For example, Kaufman[4] found no significant changes in galvanic skin response, systolic blood pressure, or pulse for 18 male and 18 female medical-surgical patients, whereas Barr and Taslitz[5] described mixed sympathetic and parasympathetic effects of a back massage on ten normal female subjects for measures of systemic blood pressure, heart rate, galvanic skin response, body temperature, pupil diameter, and respiration. Nordschow and Bierman[6] demonstrated increased trunk flexibility in 25 subjects after manual Swedish massage, indicating relaxation of voluntary skeletal muscle. Madison[7] found a significant decrease in pulse rate but no significant change in respiration following administration of the back massage to 60 nursing home residents. Madison's study is the only one that attempted to measure the individual's subjective appraisal of the back massage: 53 of the subjects described the back massage as relaxing, and 7 found it stimulating. Madison also had subjects respond to an "aversion-to-touch" rating form to screen for individuals who do not like to be touched. There were no significant trends or correlations found between a person's aversion to touch and the reported benefits of back massage, between patients' perceived severity of illness and changes in pulse or respiration, or between severity of illness and reported benefits. The lack of consistency in these findings may be explained by the variation in the type and pattern of stroking that was used to administer the massages, and the fact that some subjects had disease conditions that might have influenced the results.

It is suggested in the physical therapy literature that a slow, rhythmical, gentle, light stroking done in one direction with the hands in continuous contact with the skin will have a sedative or relaxing effect.[8] Such a modification of the traditional back massage would inhibit the autonomic (sympathetic) nervous system, and was suggested in the nursing literature by Sister Regina Elizabeth[9] and later by Temple.[10] Sister Elizabeth described a slow, rhythmical stroking down both sides of the spinous processes, two inches from the spine, from the crown of the head to the sacrum. The stroking is done at the rate of 60 strokes per minute for no longer than three minutes. Sister Elizabeth states that the slow rhythm affects the parasympathetic system but offers no documentation to support her statement.

The author could find no published research regarding the effects of a slow-stroke back massage, nor does there seem to be any systematic study of the effects of different stroking techniques used in back massage. It is essential that the predicted effects of therapeutic techniques be documented so that the nurse can select appropriate therapeutic measures. Therefore, it seemed necessary to examine the psychophysiological effects of the slow-stroke back massage (SSBM) on normal individuals who were free of disease conditions that might influence the results. Once the effects of the SSBM are documented, then an argument might be made for its use as a therapeutic technique.

REVIEW OF LITERATURE

A review of a number of studies reveals the existence of a variety of definitions and measures of arousal and relaxation, and a number of techniques for inducing relaxation.

Defining arousal-relaxation states

One difficulty in considering the use of relaxation techniques is that there is no clear definition of relaxation. Relaxation has been referred to as a state at the lower end of a continuum of arousal. Arousal is a construct that has been used to indicate a level of intensity of behavioral responses to environmental, psychological, and physiological stimuli.[11] The level of arousal is governed by multiple interacting levels and patterns of neural-hormonal regulation in which input from many sources is processed to yield complex response patterns.[12-14] A model of the various levels and primary structures involved in the determination of the level of arousal is illustrated in Fig 1.

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The model illustrates that cognitive, emotional, and voluntary motor commands from the cortex (Level 5) influence and are influenced by the degree of stimulation of the reticulo-limbic system, the degree of sympathetic versus parasympathetic stimulation, and the integrating function of the cerebellum on motor activity (Level 4). The stimulation of the brain stem structures, in turn, causes changes in the organs of the heart, skeletal muscles, and blood vessels of the skin and skeletal muscles (Level 3). The hemodynamic and muscular tension patterns (Level 2) are reflected in parameters of brain wave, heart rate, blood pressure, skin resistance, skin temperature, and muscle tension (Level 1). The reticulo-limbic system is the primary integrator of the levels of arousal.[3] Arousal, therefore, is not a single-response continuum but has cognitive-attentional, emotional, somatic, and autonomic components.[12,13]

Psychophysiological indices of arousal

In the studies reviewed by the author, a number of different parameters were used to measure levels of arousal and the effects of relaxation techniques. The lack of consistent parameters makes it difficult to compare findings of different studies.

Blood pressure and heart rate

The most frequently used indices for the level of autonomic arousal are blood pressure (BP) and heart rate (HR). Most of the current research into the effectiveness of behavioral relaxation methods has been done with hypertensive subjects; therefore, the major index used for relaxation in these studies has been blood pressure response.

All methods seem to produce modest, albeit usually statistically significant, falls in blood pressure that, despite a lack of comparative baseline data, are nevertheless similar in magnitude. The declines reported are up to 20/10 mm Hg for biofeedback, 8/6 to 37/22 mm Hg for relaxation, 20/10 to 40/20 mm Hg for psychotherapy, and an average of 37/19 mm

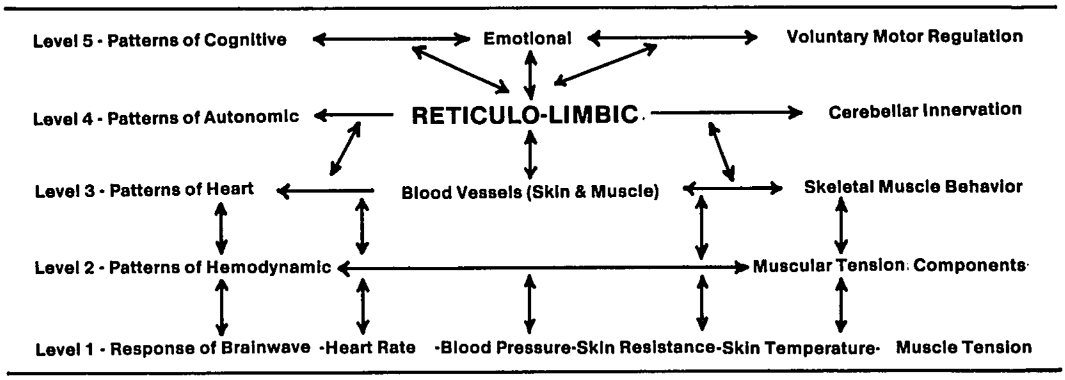

Fig 1. Levels of analysis underlying arousal mechanisms (adapted from Schwartz[12]).

Hg for hospitalization, with wide variability among individual patients.[15(p633)]

Decreases in blood pressure were interpreted as a decrease in sympathetic nervous system stimulation, with parasympathetic vagal stimulation interpreted as reasonable for decreases in heart rate.

Physiological measures

Two physiological measures, skin temperature (ST) and galvanic skin response (GSR), have been used in research to indicate the emotional and attentional levels of arousal. An emotionally stressful or alerting stimulus will activate the sympathetic nervous system, causing a release of catecholamines that will cause vasoconstriction of blood vessels supplying the skin and will lower skin temperature. Experiments in which emotional disturbances were induced showed that decreases in finger temperature were associated with conditions of conflict or danger, whereas increases in temperature were associated with emotional security.[16,17] The GSR is the electrical resistance of the skin measured by two electrodes to which a current is applied. Decreased resistance results from increased sweat gland activity brought about by sympathetic stimulation.[17,18] Findings related to GSR and other measures of sympathetic nervous system activity have indicated that GSR represents changes in emotional or attentional (motivational) state uninfluenced by changes in HR, whereas HR seems to be influenced primarily by skeletal muscle (somatic arousal) activity.[19,20] There are problems interpreting studies using GSR because of a lack of standardization of terminology and methodology.[21]

Somatic arousal

Muscle tension has been used to indicate the degree of somatic arousal. Leaf and Gaardner[22] advocate surface electromyography (EMG) as the best indicator of general muscular tension when coupled with an EMG integrator, a device that sums up the voltage generated in a storage capacitor for a fixed time interval. In a series of experiments, Stoyva and Budzynski[23] found that the frontalis muscle was superior to the forearm muscle for indicating general bodily tension. They found that reduction of muscle tension was associated with other bodily responses, such as decreased heart rate, electroencephalogram (EEG) changes, and subjective reports of pleasure. Lader and Matthews[24] summarized the findings related to EMG as follows: Subjective feelings of tension correlated more closely with skin conductance (the reciprocal of GSR[21]) than EMG levels; elevated tension levels were documented in anxious patients, depressed patients, and schizophrenic patients, indicating a psycho-emotional link to somatic activity; and subjects who had been taught to lower muscle tension were able to reduce symptoms in situations associated with somatic symptoms of tension (ie, writer's cramp and migraine headache).

Cortical or cognitive arousal

In 1949 Moruzzi and Magoun demonstrated that stimulation of the reticular formation in the brain stem produced EEG changes identical to those seen in physiological arousal reactions.[25] Alpha waves occurred in relaxed persons whose eyes were closed[26,27]; theta waves occurred in persons in meditative, creative, or hallucinatory states[27,28]; beta waves were associated with the normal waking experience; and delta waves occurred only during sleep.[27] Thus, EEG changes have been used in psychophysiological research to document cortical or cognitive arousal.

Psycho-emotional responses

Various methods have been used to measure or quantify an individual's psycho-emotional response to different situations. The individual's subjective appraisal of a situation as stressful or nonstressful is based on that individual's past experiences, threshold for stress, and ability to recognize danger and cope with the stress. The appraisal of a situation as anxiety-provoking for an individual has been described by Spielberger et al[29] as *state anxiety.*

> State anxiety refers to the complex emotional reaction or state that is evoked by situations that are interpreted as personally threatening ... as emotional reactions, anxiety states (A states) are characterized by feelings of tension, apprehension, and nervousness, and by heightened activity of the autonomic nervous system.... If an individual perceives a situation as threatening, irrespective of the presence of a real stress (objective danger), he will respond to this perceived threat with an elevation in A state.[29(p16)]

Low levels of arousal have also been associated with the psycho-emotional responses of low state anxiety.[11,29]

The complex interaction of the various levels and structures of the central nervous system make it difficult to use any one index of arousal level. Rather, several factors need to be measured and interpreted according to the interaction between the cognitive-attentional, emotional, somatic, and autonomic components. However, in general, it may be stated that high levels of arousal are characterized by increases in blood pressure, heart rate, EMG, high-anxiety scores, beta-wave EEG, and decreases in GSR and skin temperatures. Low-arousal levels are associated with decreases in blood pressure, heart rate, EMG, low-anxiety scores, increases in GSR and skin temperature, and delta- or theta-wave activity.

Relaxation and relaxation techniques

Low levels of arousal in humans have been described as a state of relaxation. Benson et al[30] describe a series of physiological changes, which they term the *relaxation response,* whose effects are opposite to those of the general adaptation syndrome described by Selye.[31] Benson et al[30,32] proposed that the relaxation response is an integrated hypothalamic response that decreases sympathetic nervous system activity and perhaps increases parasympathetic activity. The relaxation response "is characterized by decreased oxygen consumption, heart rate, respiratory rate, arterial blood lactate, and markedly increased skin resistance. The EEG demonstrates an increase in the intensity of slow alpha waves and occasional theta activity ... these changes occur simultaneously and are consistent with those noted by Hess et al in the cat."[30(p50)]

Relaxation techniques that lower arousal levels are currently being investigated. Accumulating research indicates that relaxation techniques may be useful adjuncts to pharmacological management of disease conditions or maladaptive life-style patterns in which hyperarousal is a component. Hyperarousal, if maintained for long periods, seems to interfere with the ability of the individual to relax.

> Stressed individuals will show physiological hyperarousal in one or several bodily systems ... frequently stressed (or over-reactive individuals) are likely to lose the ability to relax well, i.e., to shift to a low arousal condition. When faced by recurring stresses, the individual must repeatedly mobilize his physical and mental resources. Such responding characteristically involves sympathetic activation and elevated muscle tension, a readiness to respond to threats and challenges—the "fight-or-flight" response or "defense-alarm" reaction. Individuals forced frequently to mobilize themselves to meet stresses are likely to lose their ability to execute the opposite response, i.e., to shift into the parasympathetic mode in which bodily recuperation normally occurs.[23(p369)]

Relaxation techniques can be classified according to the mechanisms used to decrease aspects of arousal. The most extensively researched are the behavioral techniques that influence arousal levels by cortical processes: the individual attempts, through practiced conditioning, to consciously control the body's physiological response—to lower blood pressure, heart rate, or muscle tension while maintaining a mental receptivity or altered state of consciousness.[33] Examples of behavioral techniques include meditation,[28,33-35] Yoga,[36,37] biofeedback,[23] and progressive muscle relaxation.[38-40]

Another group of relaxation techniques is based on the modification of incoming neural input. These are called *sensory integration techniques* and include the use of sensory modalities (ie, touch, audition, vision, proprioception, olfaction, and vestibular stimulation) to suppress or excite the brain stem reticulo-limbic system, causing change in motor function and possibly influencing the activity of the autonomic nervous system.[41,42] Sensory integration techniques exert their influence on arousal primarily at subcortical levels and are based on the plasticity of the central nervous system.[41] *Plastic inhibition* or habituation is defined as "a simple learning not to respond to stimuli which tend to be without significance in the life of the animal; a tendency merely to drop out responses."[43(p196)] Habituation is considered a means by which the nervous system processes stimuli to lower the level of arousal.

Habituation occurs in animals with exposure to a repetitive, monotonous stimulus in a uniform external environment and occurs at various levels of the nervous system: In specific sensory pathways (ie, auditory, olfactory, visual, and tactile[43]) and in individual reticular units.[44] Involvement of the frontal areas of the cerebral cortex is necessary for the achievement of habituation.[45] Bohlin's[46] findings support the hypothesis that monotonous stimulation is inhibiting and that the same mechanisms are responsible for habituation and sleep onset in humans. The rate of habituation is faster at the cortex and slower at the first sensory synapse. The role of the cortex appears to be related to its ability to remember previous experiences; that is, it can interpret whether a stimulus is neutral or life threatening.[43] Certain individuals have nervous systems that interpret touch as arousing and are said to be "tactually defensive."[41]

SSBM as a sensory integrative relaxation technique

The slow-stroke back massage may reduce muscle tension not only by habituation to tactile sensations but also through inhibition of the muscle spindle by the passive stretch on the tendinous insertion of the muscles caused by the massaging hand. However, "the effect of the [localized] sensory input seems to be quite temporary, lasting only a few minutes, as opposed to that (sensory) input (via the spinoreticular tract) which has a prolonged effect through the reticular system."[41(p125)] This temporary effect may explain Sister Regina Elizabeth's[9] observation that the effects of SSBM lasted for only three minutes.

The role of the cortex appears to be related to its ability to "remember" previous experiences; that is, it can interpret whether a stimulus is neutral or life threatening.

Assuming that muscle relaxation occurs with SSBM, it is expected that the effects of SSBM would be similar to the effects described for progressive muscle relaxation. Jacobsen[38] trained subjects to relax through EMG feedback. He found that subjects trained to relax achieved relaxation more rapidly and completely than untrained subjects[38] and that large increases in EMG tension were associated with decreases in BP[39] and HR.[40] Using subjects with normal blood pressures, Jacobsen demonstrated that falls in BP during progressive muscle relaxation are not the result of the prone position.

> Individuals lying down do not necessarily relax; their various muscles may show varying frequencies and magnitudes of action potentials. During such moderate relaxation, no marked fall of blood pressure occurs... Blood pressure appears to remain approximately stationary during the rest period (beginning 15 min. after the change in posture), if the patient remains relaxed throughout, when it is at a relatively low level for that individual; but approximately stationary also, although at a higher level, if his muscles continue somewhat

tense throughout and the fluctuations are not greatly at variance.[39(p1211)]

The combination of decreased muscle tension, habituation to repetitive, monotonous tactile stimulation, and decreased (or low) cortical stimulation by the SSBM may influence the autonomic nervous system through thalamic interconnections and induce a general relaxation response.

A CLINICAL STUDY OF SSBM

This study of slow-stroke back massage sought to answer several questions. First, does the SSBM induce relaxation as evidenced by two or more of the following psychophysiological effects: a decrease in anxiety, heart rate, blood pressure, or generalized muscle tensions; an increase in galvanic skin response or skin temperature? Second, are the effects of SSBM limited to a three-minute massage or do they persist in a massage as long as six minutes? Third, what prolonged effects does SSBM have ten minutes after cessation of the massage?

Method

Design

This exploratory study used repeated measures to examine selected psychophysiological effects of SSBM administered for three and six minutes. The study was divided into five time periods:

1. an initial (I) reading at one minute
2. a baseline (B) period of ten minutes
3. a three-minute massage (M_3)
4. a six-minute massage (M_6)
5. a ten-minute rest period (R_{10})

The independent variables were SSBM and the length of time it was administered. The dependent variables were anxiety, generalized muscle tension (EMG), HR, systolic and diastolic blood pressure (SBP, DBP), GSR, and finger temperature (ST). Time and financial constraints prohibited the inclusion of EEG as a measure in this study.

Sample

Thirty-two volunteer Caucasian female subjects were recruited from the faculty, staff, and student population at a large Midwestern school of nursing. Inclusion in the study was based on subjects' statements that they had no history of diagnosed heart disease, elevated blood pressure, streptococcal infection, diabetes, pulmonary, or renal disease, and were not currently pregnant nor taking medications for "blood pressure, heart, or kidneys." Subjects ranged in age from 19 to 52 years, with a mean age of 31.5 years.

Subjects were asked on a background information sheet to describe the type of exercise they did and how often this was performed each week. The most frequently reported types of exercise were running or jogging and calisthenic or stretching exercises. The frequency of exercise varied from two to seven times per week.

Five subjects reported practicing a relaxation technique currently or in the past. One subject used deep breathing and concentration (approximately three times per month). One subject reported using imagery every day to relax. Another subject reported a daily 20-minute rest period, usually lying down, as her relaxation technique. Two subjects had used Yoga, one was currently taking a class in Yoga and practiced 30-40 minutes three to four times per week, and the other subject was not currently using Yoga.

It was assumed that measurement procedures would not produce reactivity (ie, the process of measuring the psychophysiological variables would not cause changes in the variables themselves). The basis for this assumption was that all subjects were nursing students or were in a medical field where they were familiar with instrumentation procedures such as the taking of blood pressure, electrocardiograms, and the use of electric thermometers. Subjects who volunteered for the study were presumed not to be tactually defensive. The SSBM was assumed to be a psychoemotionally neutral event (ie, the SSBM would be perceived as nonthreatening since most subjects would be familiar with the use of massage).

Procedure

The study was conducted in a large laboratory at a school of nursing. Attempts were made to mitigate environmental stimuli by decreasing illumination, noise, and interruptions during the sessions. Room temperature varied from 75 F to 84 F (M = 77.4 F), humidity ranged from 39% to 68% (M = 48.2%), and barometric pressure was relatively constant (28.8% to 29.8%; M = 29.06%). The study was conducted at the convenience of the subject between midmorning and early afternoon or in the early evening. Data collection was completed during the months of April and May 1980.

Individuals who met eligibility requirements were given a one-hour appointment. Each subject was instructed to avoid eating and smoking at least two hours before her appointment, to obtain a good night's sleep, and to allow plenty of time to arrive for her appointment without hurrying.

Prior to each session, the subject was familiarized with the procedure of the study and was given an opportunity to ask questions. The subject was told that the purpose of the study was to examine the effects of a slow-stroke back massage. The word *relaxation* was not used in the explanation to avoid biasing the subject's perceptions. After informed consent was obtained, the subject was asked to empty her bladder and to change into a hospital gown. The Spielberger State-Trait Anxiety Inventory (STAI-Form X-1) was administered. Then the skin was prepared and electrodes were attached. All electrodes were applied according to manufacturers' instructions for skin preparation, using high-conductance electrode cream (Electro-Sol) and hypoallergenic (Dermi-cel) tape. The subject was positioned prone on a hospital-type bed with her feet supported by pillows, and pillows were arranged under her head for comfort. A sheet was draped over the subject's legs and buttocks, and powder was applied to the subject's exposed back. The blood pressure cuff was applied to the right arm, and a trial BP reading was obtained to check the cuff placement; adjustments were made, if necessary.

The subject was told that after a ten-minute rest period, the researcher would lightly rest her hands at the top of the shoulders along the spine just prior to commencing SSBM, which was demonstrated. The subject was instructed that she was to lie quietly with her eyes closed for the entire session, lasting approximately 27 minutes, but to avoid going to sleep. Silence would be maintained until the session was completed. At the verbal signal of the researcher, the subject closed her eyes, and the instruments were turned on.

An initial reading (I) of all variables were taken one minute after the onset of the 27-minute experimental period. The HR and GSR, during the next 26 minutes, were recorded continuously for a one-minute period every five minutes during the baseline and rest periods ($B_{4\text{-}5}$, $B_{9\text{-}10}$, $R_{4\text{-}5}$, and $R_{9\text{-}10}$) and every three minutes during the massage period ($M_{2\text{-}3}$ and $M_{5\text{-}6}$). The blood pressure was taken every five minutes during the baseline and rest periods (B_5, B_{10}, R_5, and R_{10}) and every three minutes during the massage period (M_3 and M_6). The ST and EMG were read from the oscilloscope and digital readout, respectively, and recorded by the research assistant every minute. The electromyograph timer was used to time the events (ie, one minute elapsed between each digital readout).

All back massages were administered by the investigator in an attempt to ensure consistency of technique. Each subject was given an uninterrupted six minutes of SSBM. The sex of the investigator (who was female) was presumed not to increase arousal levels, since it has been accepted practice in the American culture for a nurse, who is usually female, to administer a back massage to another female.

At the conclusion of the session, the electrodes were disconnected and the blood pressure cuff was removed from the subject. Any spontaneous comments made by the subject regarding the effects of the back massage were recorded. The session concluded after the subject completed the STAI postmeasurement form.

Data analysis

The data were analyzed using a correlated *t* test for paired samples for the dependent variables (STAI, HR, SBP, DBP, GSR, EMG, and ST) at all time periods (I, B_{10}, M_3, M_6, R_{10}) to examine for significant ($p \leq .05$) changes in each variable over time. Technical problems with recording pens caused the deletion of some data, and such cases were omitted from the data analyses. The STAI was examined for internal consistency using Cronbach's alpha. A Pearson correlation was computed between the STAI and all dependent variables for all time periods. Further analysis was conducted to check for possible effects of intervening variables using a one-way, repeated-measures analysis of variance (ANOVA) between selected dependent variables and intervening variables (age, time of day, relaxation, and exercise) for all time periods.

Limitations

The fact that a convenience sample of adult female subjects was used limits the generalizations that can be made to the general population.

The setting in which the study was conducted contained a steadily blowing ventilation fan, and the hum of the recording equipment, which, as sources of monotonous auditory stimuli, may have had a habituating effect on the subjects. However, this noise was a systematic source of variation for each subject.

The psycho-emotional experience of the subject during the massage itself was not described. The number of intruding thoughts, discomforts, or anticipations may have contributed to variations in GSR or ST during the massage. Further, no attempt was made to evaluate the presence of psychosocial or situational-maturational stress in the subjects' lives.

Results

General observations

Four subjects were believed to have fallen asleep during the study, as evidenced by EMG levels below 1 μV, spontaneous muscle twitching, or snoring. However, only two subjects actually had to be aroused from sleep at the end of the study.

Three subjects reported feeling vibratory sensations toward the end of the six-minute back massage and thought that the investigator had submitted a vibrating device instead of using her hands. The vibrations were said to begin in the lower back, spread up the spine, and cause a feeling of relaxation.

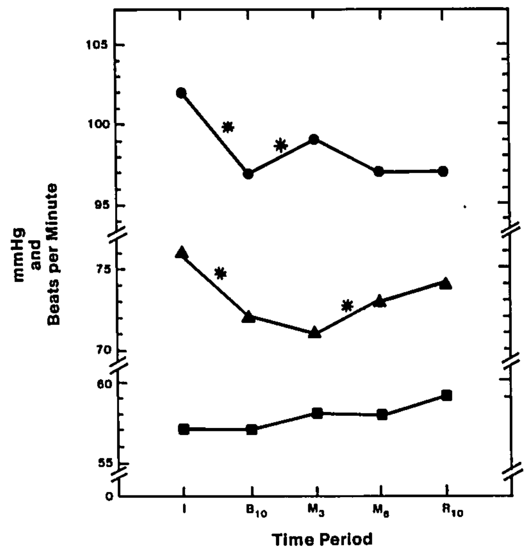

Fig 2. Mean scores for systolic and diastolic blood pressure, and heart rate for all time periods (* indicates significant differences between time periods). ● = mean systolic blood pressure (range of *SD* = 21.64 to 23.04), ▲ = mean heart rate (range of *SD* = 11.60 to 13.03), ■ = mean diastolic blood pressure (range of *SD* = 13.09 to 14.67).

Dependent variables

The data showed that STAI scores decreased significantly after the massage, $t(31) = 5.52, p < .0001$. Internal consistency was high for both the pretest STAI (alpha coefficient = .84) and the posttest STAI (alpha coefficient = .90).

Fig 2 illustrates the changes in mean SBP, DBP, and HR. Significant decreases occurred for mean SBP, $t(29) = 3.39, p < .002$, and mean HR, $t(29) = 3.82, p < .001$, during the baseline (I to B_{10}) period. Mean SBP increased during the first three minutes of massage, $t(29) = -2.74, p < .01$, whereas mean HR increased during the last three minutes (M_3 to M_6) of the massage, $t(29) = -3.25, p < .003$. There were no significant changes in DBP. Table 1 summarizes all significant findings.

Changes in mean GSR (Fig 3) and mean ST (Fig 4) showed similar trends until the final rest period. Significant increases occurred in mean GSR, $t(29) = -4.65, p < .0001$, and mean ST, $t(29) = -2.48, p < 0.19$, during the baseline period. Both GSR and ST showed a nonsignificant decreas-

Both galvanic skin response and skin temperature showed a nonsignificant decreasing trend during the first three minutes of massage and a slight increase during the last three minutes of massage.

Table 1. Summary of significant correlations between time periods for the physiological variables

Variable	Time period	*df*	*t* value	*p*
SBP	I-B_{10}	29	3.39	.002
	B_{10}-M_3	29	−2.74	.010
HR	I-B_{10}	29	3.82	.001
	M_3-M_6	29	−3.25	.003
GSR	I-B_{10}	29	−4.65	.000
	M_6-R_{10}	29	−3.07	.005
	B_{10}-R_{10}	29	−3.19	.003
EMG	M_6-R_{10}	31	2.45	.020
ST	I-B_{10}	30	−2.48	.019
	M_6-R_{10}	30	3.61	.001
	B_{10}-R_{10}	30	2.76	.010

ing trend during the first three minutes of massage and a slight increase during the last three minutes of massage. A significant ($p < .003$) increase in mean GSR occurred during the final rest period, and mean ST decreased ($p < .010$) (see Table 1).

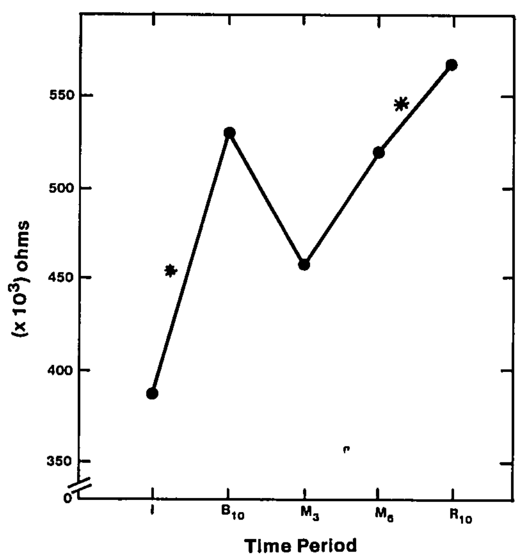

Fig 3. Mean GSR scores for all time periods (* indicates significant differences between time periods).

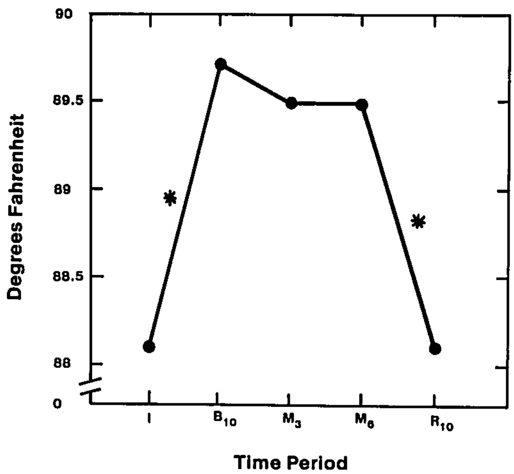

Fig 4. Mean skin temperatures for all time periods (* indicates significant differences between time periods).

The mean EMG scores (Fig 5) showed a decreasing trend throughout the study. However, the only significant decrease occurred during the final rest period, $t(31) = 2.45$, $p < .02$ (see Table 1).

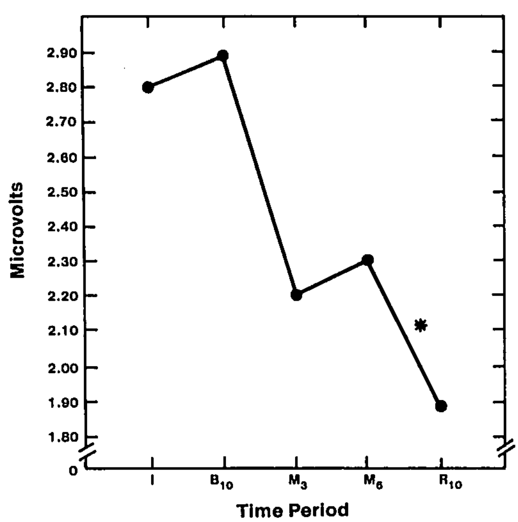

Fig 5. Mean EMG scores for all time periods (* indicates significant differences between time periods).

Intervening variables

Subjects' age correlated significantly with initial, baseline, three-minute and six-minute massage period heart rates. Higher mean heart rates were found in the two extreme age groups, the 19- to 22-year-olds and the 42- to 52-year-olds. Table 2 shows that subjects who practiced relaxation techniques ($n = 5$) had significantly lower mean heart rates than those who did not ($n = 26$). Significant changes in heart rate itself occurred in the six-minute massage period (M_3 to M_6). Therefore, SSBM was believed to account for the change in heart rate during the massage and was not the effect of either age, use of relaxation techniques, or anxiety. Data were also examined to determine the possible effects of circadian rhythm on the dependent variables. An analysis of variance showed no significant effects for time periods. Likewise, exercise had no significant effect on any variables in the study.

Review of the literature indicated that the environmental temperature, humidity, and barometric pressure may influence the GSR and ST.[21,47] However, a Pearson correlation showed no significant effects on GSR or ST for humidity, barometric pressure, or room temperature.

Discussion

Indicators of relaxation

The first question this study sought to answer was whether the SSBM would induce relaxation by lowering some aspects of arousal through subcortical habituation to tactile stimulation. The results of the STAI indicated that the slow-stroke back massage was perceived as relaxing by the subjects. This result was, in fact, verified by subjects who stated that they felt relaxed or rested after the massage. A comparison of the results of this study with the normalized data of Spielberger et al[29] (see Table 3) suggests that SSBM subjects were less anxious prior to SSBM than college females immediately prior to a written examination. This finding supports the assumption made at the beginning of the study that the anticipation of contact with instrumentation was not anxiety provoking to the subjects. Comparison of the mean posttest STAI scores ($M = 28.13$) obtained in the present

Table 2. Cell means and *F* ratios for ANOVA by relaxation with heart rate as dependent variable

Mean HR: No relax ($n = 26$)	Mean HR: Relax ($n = 5$)	Time period	*df*	*F* ratio	*p*
77.19	63.00	I	1, 29	5.6571*	.024
73.80	63.00	B_{10}	1, 28	3.6878	.065
73.44	59.80	M_3	1, 28	5.2316*	.029
75.24	61.60	M_6	1, 28	6.0567*	.020
74.61	64.20	R_{10}	1, 29	3.5246	.071

*Indicates significant differences.

Table 3. Comparison of STAI results to standardized norms for college females

Study	*M*	*SD*	Alpha coefficient
Back massage ($n = 32$)			
Pre	34.50	8.112	.84
Post	28.13	8.087	.90
Standardized norms* ($n = 88$)			
Norm	37.24	10.27	.91
Exam	43.69	11.59	.93
Relax	29.60	6.91	.83

*Norms reported by Spielberger et al[49].

study to the standardized norms for different conditions indicate that SSBM subjects most closely resembled normalized data for subjects taught progressive muscle relaxation ($M = 29.60$).

The premassage and postmassage STAI scores obtained in this study did not significantly correlate with the other psycho-emotional indices of mean GSR and mean ST. Likewise, GSR and ST did not covary as might be expected for these two measures of psycho-emotional responses. These findings tend to support the suggestions by Gatchel et al[47] that the various components of arousal (cognitive, attentional, somatic, and psycho-emotional) produce different response patterns for measures of skin conductance, anxiety, and HR.

The SBP, HR, GSR, and ST showed significant changes during the baseline period (I to B_{10}) consistent with decreased arousal, which was expected to occur as the subjects achieved their basal condition. The pattern of change for DBP, although not significant, mirrored the pattern of SBP. EMG levels, although not significant, did show an increase during the baseline period, in spite of the cessation of voluntary muscle activity. Jacobsen[39] also found that individuals lying supine showed varying degrees of muscle activity during a 15-minute rest period.

Duration of SSBM

The second research question deals with the comparison of the three- and six-minute massages. The three-minute SSBM produced a significant increase in SBP, which indicates autonomic arousal. This increase may represent stimulation of the reticular formation vasomotor centers by the delayed effect of the baroreceptor response to the baseline fall in SBP,[3] the effect of the introduction of the tactile stimulation of the back massage,[8] or both. Nonsignificant decreases in GSR and ST could be indicative of an increased level of arousal caused by stimulation of the reticulo-limbic system from the projection of tactile sensory pathways, or they may be explained by the phenomenon termed *tactile defensiveness.*[8]

In contrast, HR and EMG, although not

significant, both decreased. The decrease in mean EMG might be explained as a decrease in generalized muscle tension caused by a lack of voluntary motor activity and decreased stimulation of the alpha-gamma coactivation system of the antigravity muscle because of the prone position. In addition, the mechanical stimulation by the massage of muscles in the back may reflexively inhibit tension of the muscle spindle.[8,48] The correlation of changes in HR and EMG are similar to the findings of Miezejeski[19] and Goldwater and Lewis'[20] that HR may be more reflective of somatic muscle activity than psycho-emotional or attentional processes.

The major effect of the three-minute SSBM, therefore, was an increase in autonomic arousal. The increased autonomic arousal was associated with a concomitant (but nonsignificant) psycho-emotional or attentional arousal and decreased (but again nonsignificant) somatic arousal.

The six-minute SSBM showed a significant increase in mean HR (2 beats per minute, bpm). Barr and Scott[6] found similar increases in HR (4.7 bpm) after five minutes of a traditional back massage. The change in heart rate is again associated with a similar (but nonsignificant) change in the EMG, which also increased. The SSBM initially may have reflexively inhibited the muscle spindle, and the increase in EMG with continued massage may be the phenomenon that Wood[41] described as the relatively short reflex effect of massage in inhibiting muscle tension. SBP and DBP tended to decrease during this period, whereas the GSR increased and ST remained stable. These trends were not significant but are consistent with lower arousal of the autonomic and psycho-emotional components. This trend supports the view that habituation to the tactile sensation of SSBM occurs.

Prolonged effects

Prolonged effects of the SSBM were examined by changes occurring in the final rest period. Mean SBP, DBP, and HR did not change significantly during the final rest period. Comparisons of the baseline period to the final rest period showed no significant differences between these two rest periods for SBP, DBP, or HR. These findings are consistent with those of Jacobsen,[39] who found no cumulative effects on blood pressure or heart rate caused by the supine or prone position alone. Mean GSR and ST increased significantly during the final rest period. The significant increase in GSR during the rest period indicated low psycho-emotional arousal and may be attributed to the delayed effects of SSBM. Skin temperature decreased during the rest period and was significantly decreased from the baseline scores. This result is difficult to interpret, since it was anticipated that ST would increase with relaxation. The ST may have decreased as subjects anticipated the conclusion of the study; several subjects did indicate that they felt a need to change position toward the end. Perhaps ST is more responsive to cognitive-attentional processes, whereas GSR reflects the emotional component of arousal. EMG scores decreased significantly during the final rest period, indicating that the delayed effect of the SSBM was to lower generalized muscle tension. These findings indicate that SSBM was effective in lowering psycho-emotional and somatic arousal in the final rest period after the massage. The lowered psycho-emotional arousal is further validated by the significant decrease in STAI scores.

In conclusion, the effects of the SSBM as indicated by the multiple measures used in this study showed a complex interaction between the autonomic, somatic, emotional, and cognitive components. The results suggest that SSBM causes reflex inhibition of the muscle spindle to lower EMG and HR for a period of approximately three minutes, but if it is continued for six minutes, SSBM lowers autonomic arousal, presumably by habituation to the tactile sensations. The prolonged effects of SSBM were significant for decreased psycho-emotional and somatic arousal, with no significant changes in autonomic arousal from baseline levels.

Implications

The findings of this study suggest that SSBM may be an effective intervention for nurses to use with clients who have high somatic or psycho-emotional arousal. In addition, SSBM may be used safely with cardiac and hypertensive patients when increased autonomic arousal is to be avoided.

The psycho-emotional benefit of SSBM supports continued use of touch as a therapeutic modality by nurses. The possible benefits of SSBM in stress management and pain reduction programs need to be considered. The SSBM could be taught to a significant other in order to increase that individual's participation in the client's care, thereby providing direct, visible evidence of encouragement and support, and possibly encouraging the client's adherence to therapy.

The SSBM can be used in hospital settings as a cost-effective, nonpharmacological intervention to induce sleep instead of the more traditional vigorous massage given as part of bedtime routines of care.

Recommendations for further study

Replication of this study is recommended to determine whether the demonstrated effects are consistent. The SSBM should be compared to the traditional massage, and a control group should be used. The effects of SSBM on male subjects, other age groups, hospitalized patients, and hypertensive subjects need to be examined.

The EEG should be included with the other dependent criterion variables to allow for examination of cognitive arousal. The relationship between changes in the EEG and ST should be observed in an attempt to establish whether ST reflects cognitive arousal. Likewise, replication of the study will verify whether the correlation between HR and EMG is consistent. Would further decreases in autonomic arousal (SBP, DBP) occur if SSBM were continued beyond six minutes?

The continued use of multiple measures in studies such as this one is essential to the development of the "response-typology"[47] of various relaxation techniques. Studies are needed to document the effects of various therapeutic techniques so that the nurse will be able to select those therapeutic techniques that will achieve the desired outcome for the patient.

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