

Research Papers



## EFFECT OF JACOBSON'S PROGRESSIVE RELAXATION ON AUTONOMIC VARIABLES IN NORMAL ADOLESCENTS

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### Abstract

*Study design: A randomized prospective measures design. Method and Procedure: A sample of 30 healthy adolescents with the mean age of 21.20 yrs participated in the study. Subjects were randomly grouped into massage group and massage cum Jacobson's group. Each group includes 15 subjects. . Back massage was applied to one group and Jacobson's regime along with back massage to the other group. Subjects were made to lie down for 5 minutes during which instructions regarding the regimes were explained. Pre and Post readings of the following were recorded. Blood Pressure was recorded in supine position with the help of Sphygmomanometer with inflatable cuff and stethoscope. Total protocol was applied for 8 days and data was collected as pre and post data on 0 day, 4th day and 8th day. The data was analyzed between pre-0, post-4th day and post 8th day and the test results were compared and correlated.*

Results & Conclusion: there was a significant improvement in the values of GSR, SBP and DBP within the experimental group and the values of SBP and DBP within the control group. Comparison of values of GSR, SBP and DBP between the groups showed nonsignificant results. The comparison of GSR, SBP and DBP within the experimental group revealed significant results with maximum differences in the GSR parameter followed by SBP and least improvement was seen in DBP parameter. Jacobson's regime when given along with massage was found to be more effective than massage treatment alone.

**Keywords: Massage, Jacobson's progressive Relaxation, Galvanic skin Response, Blood pressure**

### Back Ground of the Study

Stress is the condition which results when personal/environmental transactions lead the individual to perceive a discrepancy –whether real or not- between the demands of a situation and the resources of the person's biological, psychological and social systems. Although the tension developed in the person can help him by making him alert or by

motivating him, in the long term, his health is affected following which even his relationships would suffer<sup>15</sup>. Relaxation is a process of maintaining a stable environment in the body and the body responds to it by - lowering the heart rate, blood pressure (BP), skeletal muscle tension, decrease in the metabolic rate and oxygen consumption, and even decrease in analytical thinking.<sup>1</sup>

The process of relaxation can be achieved by simple methods like Conscious breathing, Jacobson's progressive muscular relaxation, Autogenic training, biofeedback, mental imagery, visualization, .guided imagery, massage and meditation.<sup>17</sup>

All these techniques provide general relaxation of the body by affecting different centers of the body either locally, example, vasodilatation, enhanced venous and lymphatic drainage or through the neural control, example, higher centers in the brain controlling arousal, cognition, attention, autonomic nervous system (ANS) and the musculoskeletal system. Therefore each technique follows its own method of inducing relaxation.<sup>18</sup>

Massage, one of the relaxation techniques is defined as

manipulations of the tissues and organs of the body; these manipulations are most effectively performed with the hands and are administered for the purpose of producing effects on the nervous, muscular, and respiratory systems and the local and general circulation of the blood and lymph. It utilizes various techniques like symmetrical stroking, kneading and effleurage, which brings about local and general relaxation through various physiological mechanisms acting generally as on the ANS and locally like the Axonal reflex, improved lymphatic and venous drainage, reflex vasodilatation, controlled microtraumatization, and cellular stimulation<sup>8</sup>.

Jacobson's progressive muscular relaxation on the other hand is the most effective method to deal with the stress or the parasympathetic response. This technique was given by Edmund Jacobson (1934) following the concept of post contract perceived relaxation. Three different types of muscle contractions are normally possible – Concentric, Eccentric and Isometric.

Jacobson's procedure applies sustained Isometric contractions to the different muscle groups of the body and then the relaxation response is perceived.

In this way the subject would feel the difference between the stress in the body as tension in the muscles, and relaxation response after contract relaxing. As this is a subjective relaxation technique, the patient can be familiar with the tension in his body and relaxation after contraction. The contraction of different muscle groups are followed from distal to proximal. Scanning for residual tension after the regime is incorporated and the process is repeated in that part 2. The breathing is regulated during the session by advising to give a brief pause (2 sec) between the inspiration phase (3 sec) and the expiration phase (5-6 sec)<sup>9</sup>.

Gellhorn (1958) hypothesized that progressive relaxation reduces physiological activity through reduction in proprioceptive feedback from the muscles to the reticular system<sup>4</sup>.

Hence these relaxation techniques bring about the relaxation response by stimulating the sympathetic nervous system and inhibiting the parasympathetic nervous system. The result being a reduction in heart rate, blood pressure, sweating and muscle tension.

As there is need for quantification of the amount of relaxation the regime has brought about and its effects on various systems like heart, lung, muscle and skin, their outcomes, blood pressure, galvanic skin resistance, EMG (muscle recruitment), papillary dilatation, etc, which they influence can be measured.

#### STATEMENT OF THE STUDY

Most of the studies done on relaxation through Massage and Jacobson's progressive muscular relaxation include autonomic variables like Heart rate, Blood pressure (SBP & DBP), EMG (MUAP), Pupillary dilatation, etc. But the indices were measured either during the session or in between the session and the lasting effect (after 5 minutes) or the carry over

effect (difference from the day 0 value) was not studied. So this study tries to note the longer lasting effects of Blood pressure and GSR in the body.

#### INCLUSION CRITERIA

1. An age group of 18 -25 yrs was selected.
2. A body mass index of between 19-25 kg/m<sup>2</sup> was selected<sup>3</sup>.
3. The normal body temperature range of 98.00 - 98.60 F was selected<sup>7</sup>.
4. The resting respiratory rate, a range between (12-17/min) was selected<sup>7</sup>.
5. Subjects with normal blood pressure between 120-130 mmHg of Systolic BP and 75-90 mmHg of Diastolic BP were selected<sup>19</sup>.
6. According to the normal healthy adult, the range for the pulse rate was taken as 70-80/ min<sup>19</sup>.

#### EXCLUSION CRITERIA

1. Neurological disorders like peripheral nerve injuries, ANS involvement, CNS involvement, Spinal Cord involvement.
2. Postural imbalances like deformities of spine, limbs.
3. Respiratory diseases of obstructive and restrictive types, chest wall deformities, spinal deformities affecting chest like scoliosis, kyphosis.
4. Skin diseases and skin changes like Anhidrosis, Hyperhidrosis, Scaly skin, Infectious skin diseases, hypersensitive skin.
5. Any undiagnosed / referred pain.
6. On any sort of medication for at least past 3 months. (Sedatives, depressants, tranquilizers).
7. Any sort of stress, anxiety, depression.
8. Subjects who were not interested or could not complete the 8 days protocol.
9. Musculoskeletal disorders like any deformities or any soft tissue and muscle injuries.

#### METHOD

Subjects from both the groups (n=15) were made to lie down initially for 5 min in supine relaxed position in order to make them adapted with the experimental environment to allow for the accommodation of the ANS<sup>10</sup>. The atmosphere of the research laboratory was kept free from noise, and room temperature was maintained between 21-23°C<sup>20</sup>.

Positioning of the subject

Subjects were made to lie down supine comfortably and then the subject's Blood pressure (SBP & DBP) and galvanic skin response (resistance)

#### Blood pressure<sup>6</sup>

The left arm was exposed above the elbow till the insertion of the deltoid. The inflatable cuff was strapped and inflated. The brachial artery pulsations were heard with the help of a stethoscope.

Mercury level was noted when the pulse was heard first while deflating the cuff denoting the systolic BP. The mercury level was again noted when the diminishing of pulse was heard while further deflating the cuff

denoting the diastolic BP.

Galvanic Skin Response<sup>5</sup>

Skin Preparation-The superficial skin layer was abraded to remove the dead and dry skin cells using alcohol with cotton swabs, which can interfere with quality of recording.

Placement of Electrodes- Two Surface electrodes (small metal discs-5 mm diameter) were affixed to the skin overlying the palmar aspect of right index finger and thumb at their proximal phalanges. Electrode gel was applied beneath the surface electrode to facilitate conduction of the electrical potentials.

Recording- as the machine was turned on, the visual bars were set to base line value and the reading was noted that was displayed on the monitor.

#### PROCEDURE:

##### MASSAGE

Back massage (Beards massage)<sup>8</sup> constituting of stroking which was superficial but firm enough, effleurage constituting three strokes draining to the cervical and axillary lymph nodes, kneading comprising of palmar and finger kneading over the erector spinae and the trapezius, and ironing done over the erector spinae groups bilaterally. Percussion techniques were excluded.

##### JACOBSON'S PROGRESSIVE RELAXATION TECHNIQUE

9 was then introduced by instructing the subject to perform in the following manner:

1. Take three deep abdominal breaths, exhaling slowly each time. As you exhale, imagine that tension throughout your body begins to flow away.
2. Clench your fists. Hold for 7-10 seconds and then release for 15-20 seconds. The same time intervals were used for all other muscle groups.
3. Tighten your biceps by drawing your forearms up toward your shoulders with both arms. Hold and then relax.
4. Tighten your triceps by extending your arms out straight and locking your elbows. Hold and then relax.
5. Tense the muscles in your forehead by raising your eyebrows as far as you can. Hold and then relax. Imagine your forehead muscles becoming smooth and limp as they relax.
6. Tense the muscles around your eyes by clenching your eyelids tightly shut. Hold and then relax. Imagine sensations of deep relaxation spreading all around them.
7. Tighten your jaws by opening your mouth so widely that you stretch the muscles around the hinges of your jaw. Hold and then relax. Let your lips part and allow your jaw to hang loose.
8. Tighten the muscles in the back of your neck by pulling your head way back; as if you were going to touch your head to your back. Hold and then relax.
9. Take a few deep breaths and tune in to the weight of your head sinking into whatever surface it is resting on.

10. Tighten your shoulders by raising them up as if you were going to touch your ears. Hold and then relax.

11. Tighten the muscles around your shoulder blades by pushing your shoulder blades back as if you were going to touch them together. Hold the tension in your shoulder blades and then relax.

12. Tighten the muscles of your chest by taking in a deep breath. Hold for up to 10 seconds and then release slowly. Imagine any excess tension in your chest flowing away with the exhalation.

13. Tighten your stomach muscles by sucking your stomach in. Hold and then release. Imagine a wave of relaxation spreading through your abdomen.

14. Tighten your lower back by arching it up. Hold and then relax.

15. Tighten your buttocks by pulling them together. Hold and then relax. Imagine the muscles in your hips going loose and limp.

16. Squeeze the muscles in your thighs all the way down to your knees. Hold and then relax. Feel your thigh muscles smoothing out and relaxing completely.

17. Tighten your calf muscles by pulling your toes toward you. Hold and then relax.

18. Now imagine a wave of relaxation slowly spreading throughout your body, starting at your head and gradually penetrating every muscle group all the way down to your toes.

##### DATA ANALYSIS

Paired t-Test was used for analyzing the dependent variables i.e. GSR, SBP and DBP for within group sessions, Unpaired t-Test was used for analyzing the dependent variables for between group sessions. One way Analysis of Variance (ANOVA) and Post hoc analysis by Schiffo's test was used for comparing the values of GSR, SBP and DBP for within groups. Pearson product moment correlation (2-tailed) test was used for finding the association between the various parameters of the study.

Group A included 15 subjects with mean age of 21.20 +1.7403 yrs, and Group B included 15 subjects with mean age of 21.20+1.6987 yrs.

Within Massage group

Galvanic skin resistance

The analysis within the control group was done using paired t Test for 0 vs. 4th day, 4th vs. 8th day, 0 vs. 8th day and the results revealed Non significant improvement overtime within the control group. 'P' value was found to be Non significant ( $P > 0.05$ ).

The mean and Standard deviation of GSR value of control group at 0 day session was 209.467 + 92.90 micro ohms, and after 8th day were 211.66 + 47.86 micro ohms.

##### Systolic blood pressure

The analysis within the control group was done using paired t Test for 0 vs 4th day, 4th vs 8th day, 0 vs 8th day and the results revealed significant improvement overtime within the control group. P value was found to be significant ( $P < 0.05$ ). The mean and Standard deviation of SBP value of the Control



group at 0 day session was  $126.933 \pm 4.89$  mm of Hg and after 8th day session was  $120.933 \pm 1.27$  mm of Hg.

#### Diastolic blood pressure

The analysis within the control group was done using paired t Test for 0 vs. 4th day, 4th vs. 8th day, 0 vs. 8th day and the results revealed significant improvement overtime within the control group. P value was found to be significant ( $P < 0.05$ ). The mean and Standard deviation of SBP value of the Control group at 0 day session was  $83.33 \pm 2.35$  mm of Hg and after 8th day session was  $80.40 \pm 1.12$  mm of Hg.

Within Experimental group

#### Galvanic skin resistance

The analysis within the experimental group was done using paired t Test for 0 vs. 4th day, 4th vs. 8th day, 0 vs. 8th day and the results revealed a significant improvement overtime. P value was found to be significant ( $P < 0.05$ ).

The mean and Standard deviation of GSR value of experimental group at 0 day session was  $176.0 \pm 77.44$  micro ohms, and after 8th day were  $208.06 \pm 50.53$  micro ohms.

#### Systolic blood pressure

The analysis within the experimental group was done using paired t Test for 0 vs. 4th day, 4th vs. 8th day, 0 vs. 8th day and the results revealed significant improvement overtime within the experimental group. P value was found to be significant ( $P < 0.05$ ). The mean and Standard deviation of SBP value of the experimental group at 0 day session was  $127.867 \pm 4.24$  mm of Hg and after 8th day session was  $120.533 \pm 1.18$  mm of Hg.

#### Diastolic blood pressure

The analysis within the control group was done using paired t Test for 0 vs. 4th day, 4th vs. 8th day, 0 vs. 8th day and the results revealed significant improvement overtime within the control group. P value was found to be significant ( $P < 0.05$ ). The mean and Standard deviation of SBP value of the Control group at 0 day session was  $83.33 \pm 2.35$  mm of Hg and after 8th day session was  $80.40 \pm 1.12$  mm of Hg.

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experimental group at 0 day session was  $127.867 \pm 4.24$  mm of Hg and after 8th day session was  $120.533 \pm 1.18$  mm of Hg.

#### Diastolic blood pressure

The analysis within the experimental group was done using paired t Test for 0 vs. 4th day, 4th vs. 8th day, 0 vs. 8th day and the results revealed significant improvement overtime within the experimental group. P value was found to be significant ( $P < 0.05$ ). The mean and Standard deviation of SBP value of the experimental group at 0 day session was  $84.26 \pm 3.01$  mm of Hg and after 8th day session was  $80.40 \pm 0.828$  mm of Hg.

The analysis therefore reveals that both the types of treatment influenced Autonomic Nervous system.

#### Between subject factor

Analysis between the group A and B was done using unpaired t Test for 0 day, 4th day and 8th day for all the variables.

#### GSR

The results revealed significant differences ( $p < 0.05$ ) between both the groups. The experimental group i.e. the Jacobson's group showed an increase in GSR over a period of 8 days.

#### SBP

The results of systolic blood pressure revealed significant differences ( $p < 0.05$ ) between both the groups. The experimental group i.e. the Jacobson's group showed better reduction in SBP over a period of 8 days.

#### DBP

The results of diastolic blood pressure revealed significant differences ( $p < 0.05$ ) between both the groups. The experimental group i.e. the Jacobson's group showed better reduction in DBP over a period of 8 days.

#### Comparison of variables using ANOVA

The three variables i.e. GSR, SBP, DBP within the experimental group were compared using one way ANOVA and the analysis revealed that there was a significant difference between the three variables. However posthoc analysis revealed that all the three variables improved significantly in their values through the treatment, but GSR revealed more significant differences than the other two variables. (Refer tables 4 and 5 & tables 6 and 7 for posthoc analysis)

#### Correlation between the variables

The 8th day reading of GSR ( $208.06 \pm 50.53$ ) and SBP ( $120.53 \pm 1.18$ ) were correlated and it showed a negative correlation with the r value being -0.486. The results were found to be non significant ( $p > 0.05$ ).

The 8th day reading of GSR ( $208.06 \pm 50.53$ ) and DBP ( $80.40 \pm 0.82$ ) also showed a negative correlation with the r value being -0.081.

The 8th day reading of SBP ( $120.53 \pm 1.18$ ) and DBP ( $80.40 \pm 0.82$ ) showed a positive correlation with the r

value being 0.058. The results were found to be non significant (p>0.05).

Table – 1: Comparison of GSR values at 0

Parameters	0 Day MD	4 <sup>th</sup> Day MD	8 <sup>th</sup> Day MD
GSR vs. SBP	82.533	91.533	90.7333
SBP vs. DBP	43.60	41.06	40.533
GSR vs. DBP	126.133	132.60	131.26

Table-2: Comparison of GSR values at 0 day, 4th day and 8th day within experimental group (Group B).

Source of variance	SS	DF	MS	F value	Significance
Between	127857.7	2	63928.867	75.046	P<0.05
Within	35778.267	42	851.863		
Total	163636.0	44			

Table – 3

Comparison of GSR at 0 day, 4th day and 8th day between group A and group B.

SESSIONS	‘t’ value	‘p’	‘p’
0 DAY	-2.622	P<0.05	
4 <sup>th</sup> DAY	-2.682	P<0.05	
8 <sup>th</sup> DAY	-4.13	P<0.05	

Table - 4

ANOVA for Comparison of GSR, SBP and DBP at 8th day within the massage group

Groups	N	0 DAY ‘t’ value	4 <sup>th</sup> DAY ‘t’ value	8 <sup>th</sup> DAY ‘t’ value
A&B	30	-1.072	-0.422	-0.200
SIGNIFICANCE		p>0.05	p>0.05	p>0.05

Table - 5

ANOVA for Comparison of GSR, SBP and DBP at 8th day within experimental group

Source of variance	SS	DF	MS	F value	Significance
Between	138237.9	2	69118.956	56.896	P<0.05
Within	51023.067	42	1214.835		
Total	189261.0	44			

Table – 6 (post hoc analysis)

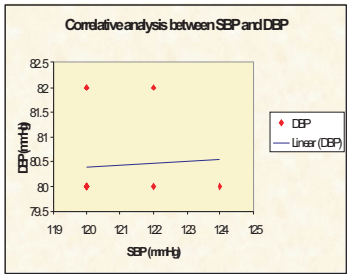
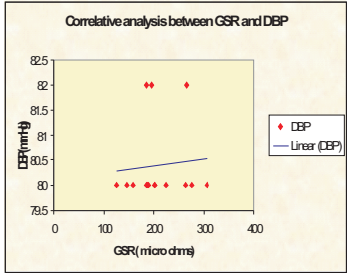
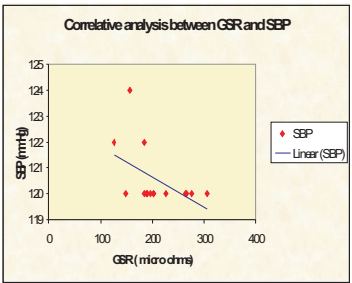
Comparison of mean difference of GSR, SBP and DBP within massage group.

SESSIONS	‘t’ value	‘p’
0 DAY	0.220	p>0.05
4 <sup>th</sup> DAY	-0.135	p>0.05
8 <sup>th</sup> DAY	0.119	p>0.05

Table – 7 (post hoc analysis)

Comparison of mean difference of GSR, SBP and DBP within Jacobson's group.

Parameters	0 Day MD	4 <sup>th</sup> Day MD	8 <sup>th</sup> Day MD
GSR vs. SBP	48.133	82.40	87.53
SBP vs. DBP	43.60	40.66	40.13
GSR vs. DBP	91.733	123.06	127.66



GSR

The findings from the present study showed a significant increase in the Skin resistance within the Jacobson's group; where as the massage group could not achieve significant improvement in resistance levels. Particularly noteworthy is the finding that there was no significant improvements in the skin resistance on comparing the two groups. The possible explanation for these findings could be the obvious increase in sweating which occurred through out massaged periods. Since only the sympathetic division of ANS is distributed to sweat glands, the effect must be the result of sympathetic stimulation.

Possibly repeated mechanical stimulation of the integument causes an local increase in metabolic activity further increasing the body heat and blood temperature which when transmitted to the temperature regulation centers of the Brain (Hypothalamus), reflexively stimulates the sympathetic nervous system

to the sebaceous glands to increase sweating and decrease body temperature.

The findings of the present study are supported by Barr and Taslitz (1970) who found a reduction in the GSR values due to sweating<sup>11</sup>.

In contrary to this finding Jacobson's group showed a significant increase in GSR values which could be due to the phenomena of increase in skin resistance with relaxation (Morse D R et al, 1977). The component of absence of sweating after PMR could be another possible mechanism of raised levels of GSR. Lehrer P M (1978) found a significant reduction in the skin conductance (increase in resistance) levels over sessions in the PMR group<sup>13</sup>. Morse D R et al (1977) also found that baseline values of skin resistance are highly variable, relatively constant over time and may not be affected by training<sup>16</sup>.

#### BLOOD PRESSURE

The reports from the present study suggest that the two treatment techniques were equally effective in reducing the SBP and DBP levels.

The immediate parasympathetic response seen in both SBP and DBP may have been the results of mechanical pressure creating an increased distensibility of the arterial bed and Vasodilatation of peripheral blood vessels. Such effects would bring about the observed reduction in SBP and DBP within massage group (Barr and Taslitz, 1970). The findings showed a reduction in SBP and DBP as an immediate response with varied delayed responses.

In terms of improvement seen in the BP within the Jacobson's group, it can be theorized that the relaxation response is proposed to have the opposite effects of stress response including low levels of cortical arousal, decreased metabolism, decreased O<sub>2</sub> consumption and reduced cellular needs. In the relaxation states sensors in the brainstem and hypothalamus provide feed back regulation to the blood pressure. It includes activation of higher limbic structures such as Amygdala and Hypothalamus which then send signals through ANS (parasympathetic branches, Acetylcholine) to decrease the blood pressure.

Thus the present study indicates the significant effects of Jacobson on BP as supported by Steven G Fey and Ernest Lindholm who concluded that significant reductions in BP can be obtained through PMR techniques.

The comparisons of mean differences of GSR, SBP and DBP within the experimental group revealed significant results with maximum improvement in GSR followed by SBP and least improvement in DBP.

The improvements in the GSR values were supported by Lehrer P M (1978) who found a decrease in the skin conductance (increase in resistance) over sessions in the relaxation group as compared with controls. Thus from findings of present study it can be yielded that GSR is an important tool for measuring ANS activity.

The importance of skin resistance in relaxation is also emphasized by Morse et al (1977) who concluded from

his study that Skin resistance levels increase during relaxation. Skin resistance is believed to be a measure of sweat gland activity and it is an important monitor of sympathetic nervous system of ANS. As such it can be used as a relatively accurate measure of subjects stress and relaxation response.

The present study also focused on finding an association amongst the variables (GSR, SBP and DBP) and the results revealed a weak positive correlation between GSR and DBP and also between SBP and DBP. Non significant negative correlation was found between GSR and SBP.

The works of Lorna Wing (1963) support the present focus of the study. She found that there was no significant correlation between skin resistance, pulse rate and EMG measures. This was also in agreement with the work of Lacey et al (1953) who also found a non significant correlation among the variables, and theorized the reasons of individual Autonomic specificity for such results<sup>12</sup>.

Alasdair A, McKechnie, Florence et al (1983) supported the present view by stating that during relaxation; the Heart rate slows down, skin resistance increases (decrease in arousal), and levels of muscle tension also decreases.

The negative correlation between the skin resistance and SBP can be explained on the same relaxation phenomena that there would be an increase in skin resistance and decrease in BP with relaxation. Barr and Taslitz (1970) in their study also reported the same finding, that is, an increase in skin resistance with decrease in SBP and DBP as an immediate response.

A positive correlation was found between SBP and DBP values which are explainable on the same basis that relaxation reduces the muscle tension and causes a fall in the BP. thus giving a positive association. Interestingly, GSR and DBP showed a weak positive correlation. This is in contrary with the normal physiological response attained through relaxation. However it can be theorized that the psycho physiological measures of physical tension and anxiety typically do not show any consist pattern when groups of individuals are compared. Individual subjects respond differently on the various psycho physiological measures (McKechnie 1983)<sup>14</sup>. This is in agreement with the works of Tart C T (1963) who stated that normally the skin resistance levels reduce with stressful stimuli and increase with relaxing stimuli. However the baseline values of skin resistance are highly variable, relatively constant over time and may not be affected by relaxation training<sup>16</sup>.

Thus the nonsignificant associations amongst the variables are in conjunction with the works of Lacey and Lacey et al (1958) who could not find a significant correlation amongst the variables in normal subjects<sup>12</sup>.

#### CONCLUSION

Thus we can conclude that both the treatment regimes were effective in inducing general relaxation and effecting the different parameters, but Jacobson's



regime when given along with massage was found to be more effective than massage treatment alone. The other finding from the study suggests that a weak association was found among the various parameters measured in the study

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