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Moderate Pressure is Essential for Massage Therapy Effects

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ABSTRACT

Moderate pressure appears to be necessary for massage therapy effects. Studies comparing moderate and light pressure massage are reviewed and they suggest that growth and development are enhanced in infants and stress is reduced in adults, but only by moderate pressure massage. The stimulation of pressure receptors leads to increased vagal activity which, in turn, seems to mediate the diverse benefits noted for massage therapy.

KEYWORDS: Moderate pressure massage therapy

MODERATE PRESSURE IS ESSENTIAL FOR MASSAGE THERAPY EFFECTS

The diverse benefits of massage therapy observed across a wide range of conditions may stem from a common underlying mechanism. Recent findings suggest that this mechanism may involve increased vagal activity from the stimulation of pressure receptors under the skin. For example, in healthy adults, massage therapy promotes relaxation and reduces stress, but only if it involves the use of moderate pressure versus light pressure (Diego & Field, 2008; Diego, Field, Sanders, & Hernandez-Reif, 2004). Similarly, the use of moderate pressure versus light pressure massage is essential for improving neurobehavioral outcomes in full-term newborns (Field, Hernandez-Reif, & Diego, 2006b) and for promoting growth in both preterm (Diego, Field, & Hernandez-Reif, 2005a; Field, Diego, Hernandez-Reif, Deeds, & Figueiredo, 2006a) and full-term infants (Field et al., 2004).

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In preterm infants, moderate pressure but not light pressure massage consistently elicited an increase in vagal activity (high frequency component of heart rate variability) and an increase in gastric motility (Diego, Field, & Hernandez-Reif, 2005; Diego et al., 2007). The increased vagal activity and gastric motility were related to weight gain in these infants, suggesting that the effects of massage therapy may be mediated by increased vagal activity. Similarly, other benefits noted for massage therapy including improved psychological outcomes (e.g., reduced depression) and improved immune function are also likely to be mediated by increased vagal activity. These studies are reviewed below.

Moderate Pressure Effects on Electroencephalography (EEG) and Electrocardiogram (EKG) in Adults

Three types of commonly used massage therapy techniques were assessed in a sample of healthy adults who were randomly assigned to a (1) moderate pressure massage, (2) light pressure massage, or (3) vibratory stimulation group (Diego et al., 2004). Changes in anxiety and stress were assessed, and electroencephalography (EEG) and electrocardiogram (EKG) were recorded. Anxiety scores decreased for all three groups, but the moderate pressure massage

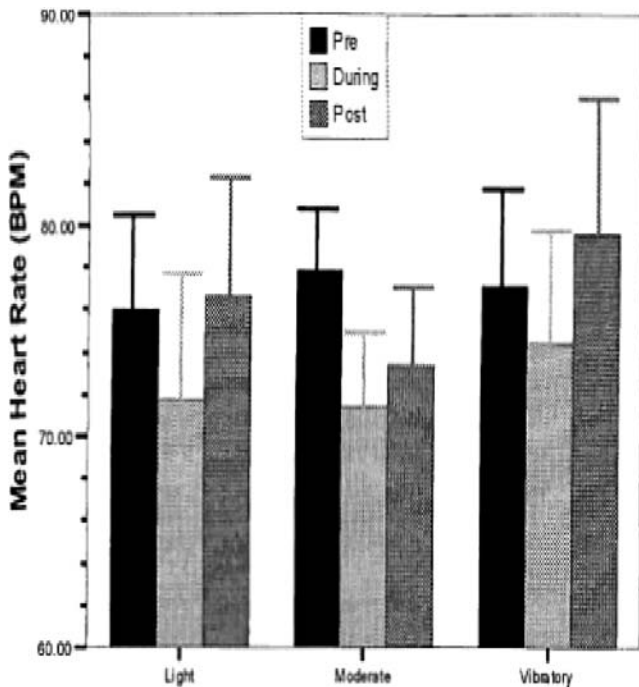


FIGURE 1 Mean heart rate in beats per minute (error bars indicate ± 2 SE) for light and moderate pressure massage and vibratory stimulation groups (taken from Diego *et al.*, 2004).

group reported the greatest decrease in stress. The moderate pressure massage group also experienced a decrease in heart rate (see Figure 1) and EEG changes including an increase in delta and a decrease in alpha and beta activity, suggesting a relaxation response. Finally, this group showed increased positive affect, as indicated by a shift toward greater relative left frontal EEG activation (see Figure 2) which typically accompanies increased positive affect. In contrast, the light pressure massage group showed increased arousal, as indicated by decreased delta and increased beta activity and increased heart rate. The vibratory stimulation group also showed increased arousal, as indicated by increased heart rate and increased theta, alpha, and beta activity.

Moderate Pressure Massage Effects on Vagal Activity in Adults

In another study, healthy adults were randomly assigned to a moderate pressure or a light pressure massage therapy group, and heart rate (EKG) was recorded during a 3-minute baseline, during a 15-minute massage period, and during a 3-minute postmassage period (Diego & Field, 2008). The EKG data were then used to derive vagal activity (the high frequency component of heart rate variability) and the low to high frequency ratio (LF/HF) as noninvasive markers of autonomic ner-

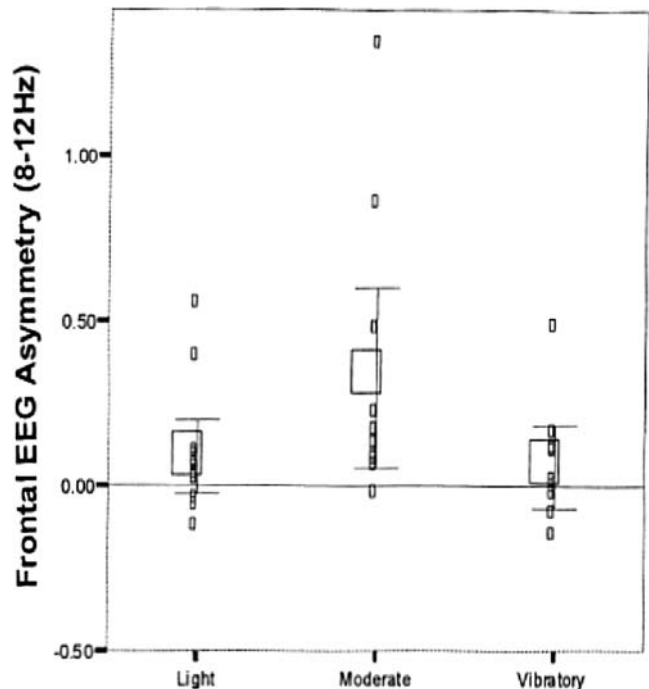


FIGURE 2 Change in frontal EEG asymmetry scores (log right – log left 8–12 Hz power) for light and moderate massage and vibratory stimulation groups. Positive values indicate a shift toward left frontal EEG asymmetry, and negative values indicate a shift toward right frontal EEG asymmetry. Horizontal lines indicate means, error bars indicate ± 2 SE, and triangles indicate individual scores (taken from Diego *et al.*, 2004).

vous system activity. The participants who received the moderate pressure massage exhibited a parasympathetic nervous system (PNS) response (relaxation) characterized by an increase in vagal activity and a decrease in the LF/HF ratio, suggesting a shift from sympathetic (arousal) to parasympathetic (relaxation) activity that peaked during the first half of the massage period. On the other hand, those who received the light pressure massage exhibited a sympathetic nervous system response (arousal) characterized by decreased vagal activity and an increased LF/HF ratio.

Moderate Pressure Massage Effects on Depressed Pregnant Women and Their Neonates

Pregnant women diagnosed with major depression were provided 12 weeks of twice per week massage therapy by their significant other or received standard treatment as a control group (Field, Diego, Hernandez-Reif, Deeds, & Figueiredo, 2008a). The therapy group women versus the control group women not only had reduced depression by the end of the therapy period, but they also had reduced depression during the postpartum period. Their newborns were also less likely to be born

prematurely and with low birth weight, they had lower cortisol levels, and they performed better on the Brazelton Neonatal Behavioral Assessment habituation, orientation, and motor scales.

In another study, prenatally depressed women were randomly assigned to a group that received moderate pressure massage therapy twice weekly from their partners from 20 weeks gestation until the end of pregnancy or a control group (Field et al., 2007). Self-reported leg pain, back pain, depression, anxiety, and anger decreased more for the massaged pregnant women than for the control group women. In addition, the partners who massaged the pregnant women versus the control group partners reported less depressed mood, anxiety, and anger across the course of the massage therapy period. Finally, scores on a relationship questionnaire improved more for both the women and the partners in the massage versus the control group. These data suggest that not only mood states but also relationships improve when depressed pregnant women are massaged by their partners.

Neonates of Depressed Mothers who Received Pregnancy Massage

Neonates of depressed mothers who had received moderate pressure massage versus light pressure massage therapy during pregnancy (month 5 through month 8) were compared on their behaviors during 15-minute observations and on their performance on the Brazelton Neonatal Behavior Assessment Scale (Field et al., 2006b). The group of neonates whose mothers had received moderate pressure massage during pregnancy spent a greater percentage of the observation time smiling and vocalizing, and they received better scores on the orientation, motor, excitability, and depression clusters of the Brazelton scale.

Moderate Pressure Massage Effects on Full-Term Infants

In the present study, mothers were instructed to massage their newborn infants once per day using either light or moderate pressure. The infants' growth (i.e., weight, length, and head circumference), sleep behavior, and performance on the Brazelton scale were assessed soon after birth and at one month of age. As compared to infants who received a light pressure massage, infants in the moderate pressure group gained more weight, were of greater length, performed better on the Brazelton orientation scale, had lower Brazelton excitability and depression scores, and exhibited less agitated behavior during sleep.

Moderate Pressure Massage Effects on Preterm Infants

Preterm infants (mean gestational age = 30 weeks) were randomly assigned to a moderate or to a light pressure massage therapy group to receive 15 massages three times per day for 5 days (Field et al., 2006a). Behavior state, stress behaviors, and heart rate were recorded for 15 minutes before and during the first 15-minute therapy session. Weight gain was recorded over the 5-day therapy period. The moderate versus light pressure massage group gained significantly more weight per day. During the behavior observations, the moderate versus light pressure massage group showed significantly lower increases from the pre-session to the session recording on (1) active sleep, (2) fussing, (3) crying, (4) movement, and (5) stress behavior (hiccupping). They also showed a smaller decrease in deep sleep, a greater decrease in heart rate, and a greater increase in vagal activity. Thus, the moderate pressure massage therapy group appeared to be more relaxed and less aroused than the light pressure massage group, which may have contributed to the greater weight gain of the moderate pressure massage therapy group.

Multiple studies have documented increased weight gain after 5 to 10 days of massage therapy for preterm neonates (see Field, Hernandez-Reif, & Diego, 2005a for a review). The massaged preterm neonates did not consume more calories than the control neonates. A potential mechanism for the weight gain effect involves massage-induced increases in vagal activity, which, in turn, lead to increased gastric motility and thereby gain in weight. In a recent study we explored this potential underlying mechanism by assessing vagal activity and gastric motility in response to massage therapy (moderate pressure) versus sham massage (light pressure) in a sample of preterm neonates (Diego et al., 2005). The preterm neonates receiving moderate pressure versus the preterm neonates receiving light pressure massage exhibited greater weight gain and increased vagal activity and gastric motility during and immediately after treatment. The vagal activity and gastric motility increases were significantly related to weight gain. Thus, the weight gain experienced by preterm neonates receiving moderate pressure massage therapy appears to have been mediated by increased vagal activity and gastric motility.

To determine whether moderate pressure massage on preterm infants leads to consistent increases in vagal activity and gastric motility and whether these increases are associated with greater weight gain, heart rate (EKG) and gastric motility (EGG) were recorded in preterm infants randomly assigned to a moderate pressure massage therapy group or to a standard care control group to assess vagal activity and gastric

motility responses to the moderate pressure massage (Diego *et al.*, 2007). The massaged infants exhibited consistent short-term increases in vagal activity and gastric motility on both the first and the last days of the 5-day study. These increases were, in turn, associated with weight gain during the 5-day treatment period.

To determine if massage therapy increased serum insulin and insulin-like growth factor 1 (IGF-1) in preterm neonates, those who averaged 34.6 weeks at the time of the study ($M = 29.5$ weeks gestational age; M birth weight = 1,237 gms) and were in the “grower” (step-down) nursery were randomly assigned to a massage therapy group (body stroking and passive limb movements for three, 15-minute periods per day for 5 days) or a control group that received the standard nursery care without massage therapy (Field *et al.*, 2008b). On days 1 and 5, the serum collected by clinical heelsticks was also assayed for insulin and insulin-like growth factor-1 (IGF-1), and weight gain and kilocalories consumed were recorded daily. Despite similar formula intake, the massaged preterm neonates showed greater increases during the 5 days period in (1) weight gain, (2) insulin, and (3) insulin-like growth factor-1 (IGF-1). Increased weight gain was significantly correlated with insulin and IGF-1. Previous data suggested that preterm infant weight gain following massage therapy related to increased vagal activity, which suggests decreased stress, and it related to gastric motility, which may contribute to more efficient food absorption. The data from this study suggested for the first time that weight gain was also related to increased serum insulin and IGF-1 levels following massage therapy. Preterm infants who received massage therapy not only showed greater weight gain but also a greater increase in serum insulin and IGF-1 levels, suggesting that massage therapy might be prescribed for all growing neonates.

Potential Underlying Mechanisms for the Moderate Pressure Massage Effects

The effects of massage therapy on various psychological and neuroendocrine factors may be mediated by the stimulation of dermal and/or subdermal pressure receptors that are innervated by vagal afferent fibers, which ultimately project to structures involved in autonomic nervous system regulation. Baroreceptors and to a lesser extent mechanoreceptors within the dermis (*i.e.*, Pacinian Corpuscles) are innervated by vagal afferent fibers projecting to the vagal nucleus of the solitary tract, the predominant source of afferent inputs to the efferent neurons of the nucleus ambiguus and the dorsal motor nucleus of the vagus (Kandel, Schwartz, & Jessel, 2000). This model is supported by our findings showing that moderate pressure (but not light pressure) massage elicits an increase in the high frequency component of heart

rate variability (vagal activity), suggesting that the stimulation of dermal pressure receptors elicits an increase in vagal activity, possibly through the activation of vagal afferent fibers. This model is also supported by several studies by our group and others indicating that moderate pressure massage therapy elicits a PNS response characterized by decreased heart rate (*i.e.*, Diego *et al.*, 2004; Kubsch, Neveau, & Vandertie, 2000), lower blood pressure (*i.e.*, Ahles *et al.*, 1999; Kubsch *et al.*, 2000), and reduced stress hormone (cortisol) levels (*i.e.*, Field, Hernandez-Reif, Diego, Schanberg, & Kuhn, 2005b).

Taken together, these findings from recent studies (*i.e.*, Diego *et al.*, 2004; Diego *et al.*, 2007) suggest that massage therapy elicits a PNS response (increased vagal activity). As much as the PNS function can profoundly affect neuroendocrine function, psychological outcomes, immune function, and growth and development, the increase in PNS activity elicited by massage therapy may explain the diverse benefits that have been documented for massage therapy.

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