Massage therapy effects on depressed pregnant women

T. Field, M.A. Diego, M. Hernandez-Reif, S. Schanberg and C. Kuhn

Eighty-four depressed pregnant women were recruited during the second trimester of pregnancy and randomly assigned to a massage therapy group, a progressive muscle relaxation group or a control group that received standard prenatal care alone. These groups were compared to each other and to a non-depressed group at the end of pregnancy. The massage therapy group participants received two 20 min therapy sessions by their significant others each week for 16 weeks of pregnancy, starting during the second trimester. The relaxation group provided themselves with progressive muscle relaxation sessions on the same time schedule. Immediately after the massage therapy sessions on the first and last days of the 16-week period the women reported lower levels of anxiety and depressed mood and less leg and back pain. By the end of the study the massage group had higher dopamine and serotonin levels and lower levels of cortisol and norepinephrine. These changes may have contributed to the reduced fetal activity and the better neonatal outcome for the massage group (i.e. lesser incidence of prematurity and low birthweight), as well as their better performance on the Brazelton Neonatal Behavior Assessment. The data suggest that depressed pregnant women and their offspring can benefit from massage therapy.

Key words: **anxiety, depression, EEG, massage therapy, pregnancy, stress hormones**

INTRODUCTION

In a recent study depressed pregnant women were noted to have elevated cortisol and norepinephrine levels and low levels of dopamine and serotonin[1]. They subsequently gave birth to newborns with depression-like symptoms[1], elevated cortisol and norepinephrine levels (stress hormones) and lower dopamine and serotonin levels, like their mothers[2]. In addition, they showed right frontal EEG activation, thus mimicking both their depressed mothers' catecholamine and EEG patterns[3]. Elevated stress hormones (including cortisol and norepinephrine) during pregnancy may lead to abortion[4], pre-eclampsia, preterm labor, intrapartum complications and low birthweight[5–8]. Depression has also been associated with postnatal problems that include feeding problems, and anxious/depressed mothers often perceive their infants as being fussy, hungry, and demanding[9].

Massage therapy may serve as an effective intervention for prenatally depressed women inasmuch as it has been noted to help related conditions. For example, massage therapy during labor has reduced labor anxiety and length of labor[10]. Massage therapy has also decreased postpartum depression as well as depression-related hormones including cortisol and norepinephrine[11].

A recent pregnancy massage study on non-depressed women[12] served as a model for the current study. In that study twenty-six pregnant women were assigned to a

***T. Field, M. A. Diego, M. Hernandez-Reif,** Department of Pediatrics, University of Miami School of Medicine, Miami, FL, **S. Schanberg, C. Kuhn,** Department of Pharmacology, Duke University Medical School, Durham, NC, USA

*Correspondence to: T. Field, Touch Research Institutes, University of Miami School of Medicine, Miami, Florida, USA. E-mail: tfield@med.miami.edu

DOI: 10.1080/01674820412331282231

massage therapy or a relaxation therapy group for 16 weeks. The massage therapy group participants were given massages by professional massage therapists and the relaxation therapy group provided their own progressive muscle relaxation exercises. The 20-min massage therapy sessions were held twice a week during their last trimester. Both groups reported feeling less anxious after the first session and less leg pain after the first and last sessions. Only the massage therapy group, however, reported reduced anxiety, improved mood, better sleep and less back pain by the last day of the study. In addition, urinary stress hormone levels (norepinephrine) decreased for the massage therapy group. The women in the massage group had fewer complications during labor. Their infants also had fewer postnatal complications, and the massage group had a lower prematurity rate (0% versus 17%).

The present study was intended to assess a more cost-effective form of massage therapy, namely having the 'significant other' instead of a massage therapist provide the massages. In addition, we assessed the massage therapy effects on fetal activity which has been notably elevated in fetuses of depressed mothers[13]. Massage therapy was expected to have positive effects on prenatally depressed women by decreasing their stress hormones and low fetal activity. After massage therapy the women were also expected to have lower anxiety, leg and back pain and fewer obstetric complications, and their newborns were expected to perform better on the Brazelton Neonatal Behavior Assessment Scale[14]. In addition, we assessed a theoretical model derived from data suggesting relationships between prenatal maternal mood states and biochemistry, fetal activity and neonatal outcomes[13,15,16] and the effects of massage therapy on these factors[12]. In this model massage therapy increases serotonin and in turn decreases cortisol and depression. In addition, serotonin is noted to reduce leg and back pain. The massage therapy is also expected to increase dopamine and, in turn, decrease norepinephrine and anxiety. Ultimately, these two pathways may lead to reduced fetal activity and better neonatal outcome (gestational age, birthweight, performance on the Brazelton Scale) (see Figure 1 for proposed model).

METHOD

Sample

Eighty-four depressed pregnant women (M = 28.8; SD = 5.7) were recruited from obstetric and gynecology clinics. The women were recruited during their second trimester, between 18 and 24 weeks gestation (M = 22.9), and randomly assigned to a massage therapy, a progressive muscle relaxation comparison group or a standard prenatal care only group (N = 28 per group). A group of 28 non-depressed women were also recruited as a comparison group. The women were of middle socio-economic status (M = 2.7 on the Hollingshead Two-Factor Index), 27% were single, and their ethnicity was distributed as follows: 46% Caucasian, 39% Hispanic, 12% African American and 3% Asian. The groups did not differ on these demographic variables.

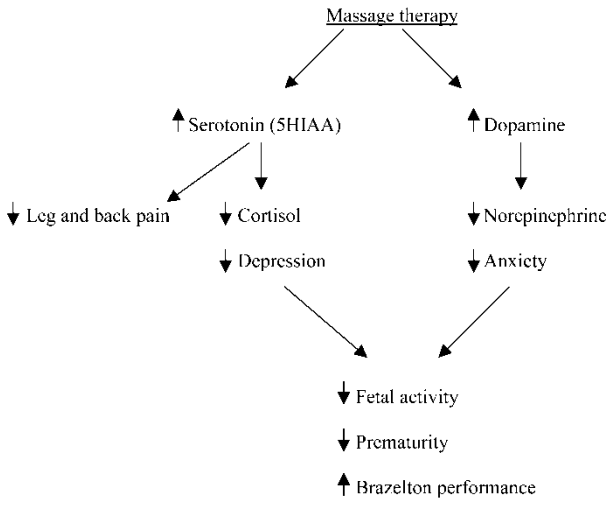

Figure 1 Potential mechanisms underlying massage therapy effects

Treatments

Massage therapy

Starting in the second trimester, the massage group received two 20-min massages per week over 16 weeks. Trained massage therapists taught the massage to the 'significant others' of the women, who then conducted the twice-weekly massages for the 16-week period. Each session began with the mother in a side-lying position, with pillows positioned behind her back and between her legs for support. The massage was administered in the following sequence for 10 min[12].

(1) *Head and neck*: massaging the scalp, making small circles from the forehead along the hairline and down to the temples, and kneading the neck from the base up.
(2) *Back*: using the heels of the hands, moving along the spine; using the palms moving the hands with rocking movements from the top of the shoulder blades to the backbone; pressing fingertips along both sides of the spine from the neck to the backbone and then stroking upward from the hips to the neck; stroking the shoulder muscles (trapezius); inching up the back, using fingertips placed on the sides of the spine, starting from the hipbone to the neck and then reversing the direction downward using fingertips in a raking fashion; massaging the lower back from the backbone across the waistline using the heels of the hands to make large circles; long gliding strokes from the hip up and over the shoulders.
(3) *Arms*: making long sweeping strokes from the elbow up and over the shoulder; kneading the muscles from above the elbow to the shoulder; stroking from the wrist to the elbow; kneading the muscles between the wrist and the elbow.
(4) *Hands*: massaging the hand using thumbs to make small circles on the palm; on the back of the hand, rubbing between the spaces of the bones; sliding down each finger.
(5) *Legs*: long sweeping strokes from the knee to the thigh, up and over the hip; kneading the muscles between the knee and thigh; long sweeping strokes from the ankle up towards the knee; kneading the muscles between the ankle and knee; sliding the hand from the Achilles tendon up towards the upper calf and sliding down to the heel with less pressure several times.
(6) *Feet*: massaging the soles from the toes to the heel with fingers and thumbs and moving back towards the toes; sliding down each toe and rotating the toes three times; stroking the top of the foot towards the leg.

The same routine was repeated once (for a total of 20 min) with the mother lying on her other side supported by pillows.

Muscle relaxation

A treatment comparison group (a muscle relaxation group) was used to control for potential placebo effects, or potential improvement related to the increased attention given to the massage therapy subjects. The muscle relaxation group was given instructions on how to conduct progressive muscle relaxation sessions while lying quietly on the massage table. A session lasted 20 min and consisted of tensing and relaxing large muscle groups starting with the feet and progressing to the calves, thighs, hands, arms, back and face. The subjects were asked to conduct these sessions at home twice a week for 16 weeks.

Measures

Pre-post treatment measures (immediate effects)

These assessments were made before and after the sessions on the first and last days of the 16-week study to document the immediate effects of the therapy.

State Anxiety Inventory (STAI)[17]

The STAI is comprised of 20 anxiety items assessing how the subject feels at that moment in terms of severity, from (0) 'not at all' to (4) 'very much so'. Typical items include 'I feel nervous' and 'I feel calm'. The STAI scores range from 0 to 80, they increase in response to stress and decrease under relaxing conditions.

Profile of Mood States Scale (POMS)[18]

The POMS consists of 15 adjectives rating depressed mood 'right now' on a 5-point scale, ranging from (0) 'not at all' to (4)

'extremely', using words such as 'blue' and 'sad'. The POMS scores range from 0 to 60.

VITAS[19]

Participants completed pre- and post-session VITAS pain scales, with reference to leg and back pain, on the first and last days of the study. Pain perception is rated on a visual analog scale (VAS) ranging from 0 (no pain) to 10 (worst possible pain), and anchored with 5 faces. The faces, located at two point intervals, range from very happy (0), to happy (2); contented (4), somewhat distressed (6), distressed (8), and very distressed (10).

First day-last day session measures (longer-term effects)

On the first and last days of the 16-week study, the following assessments were administered to document longer-term effects of massage therapy.

Center for Epidemiological Studies-Depression[20]

This 20-item scale rates depressive symptoms (e.g. 'I feel lonely') over the past week on a four-point scale: (0) 'rarely'; (1) 'some of the time'; (2) 'occasionally'; and (3) 'most of the time'. Scores range from 0 to 60, with a score of 16 being the cut point for depression.

Urine samples

Urine samples were collected on the first and last days of the study and assayed for cortisol, catecholamines (norepinephrine, epinephrine, dopamine) and serotonin (5-HIAA). There were no systematic differences in terms of sampling or the timing of collection of urine samples between the groups. Urine samples were transferred to plastic vials and were frozen without using acid or other preservatives. The samples were then sent to Duke University to be analyzed without information regarding group assignment. Urinary cortisol was assayed by radioimmunoassay using an extremely specific antiserum from Radioassay Systems Laboratories (Carson City, CA). Urinary catecholamines and serotonin were measured by high-pressure liquid chromatography (HPLC). Creatinine levels were also assayed and urine biochemistry values were then corrected for creatinine levels.

Fetal activity

This assessment was based on the procedure used in one of our earlier studies on maternal depression and fetal activity[21] and was made at 18–24 weeks (M = 22.9 weeks), and again at 36 weeks. Fetal activity was assessed using interval recording on a real-time ultrasound scanner with a single Doppler transducer applied to the mother's abdomen. Every effort was made by the ultrasound technician to visualize the entire fetus. If the fetus could not be fully visualized, the ultrasound technician focused upon the head, torso, arms, and upper leg regions, so as to permit the assessment of leg movement. Every 3 seconds, a tape-recorded cue (heard through an earphone) prompted the researcher to record the type of fetal activity occurring when the tone went off. All behavior occurring inbetween tones was ignored. The 3 second interval was arbitrarily chosen for its ability to generate an easy total (60/3 x 3 = 60 observations during the 3 min interval). The researcher recorded: a) single limb movements; b) multiple limb movements; c) gross body movements; or d) no movement. The percent time the fetus engaged in each movement category was calculated by taking the total number of movements divided by the total number of observations. In addition, total movement was calculated by subtracting 100 from the per cent time that the fetus did not show any movement.

Postnatal variables

Obstetric Complications (OCS) and Postnatal Factor (PNF) Scales[22]

Following delivery, obstetric complications and perinatal factors were quantified using the OCS and PNF scales. The OCS is a 41-item scale that assesses optimality of the *prenatal* (e.g. maternal age, medical problems during pregnancy, length of time since last pregnancy); *obstetrics* (e.g. delivery type, drugs given to mother during labor and delivery, fetal heart rate during labor, prematurity); and the *neonatal* period (e.g. placenta previa, onset of stable respiration, Apgar scores). A higher score is optimal and indicates fewer complications.

The PNF is a 10-item scale that assesses complications of the newborn (e.g. respiratory distress, temperature disturbance,

feeding within 48 h). A higher score is optimal. The OCS and PNF were completed after delivery from information collected from the medical records.

The Brazelton Neonatal Behavior Assessment Scale[14] was given within a few days after birth. The Brazelton assessments were performed by researchers who were trained to 0.90 reliability and were blind to the group classification of the mothers and infants. This neurobehavioral examination consists of 28 behavior items, such as responses to a face, voice and rattle and self-regulation behaviors, each scored on a nine-point scale, and 20 elicited reflexes, each scored on a three-point scale. The newborn's performance was summarized according to the traditional clusters[23], and Lester and Tronick's (1992) depression, excitability and withdrawal factors[24].

Statistics

Repeated measures by group (massage/relaxation/depressed control/non-depressed control) MANOVAs were conducted. The repeated measures were the pre- and post-massage therapy or relaxation session measures for the first and last days of the study. ANOVAs were subsequently conducted to determine specific effects, and interaction effects were tested by Bonferroni *t*-tests.

RESULTS

Prenatal biochemistry (see Table 1)

A significant MANOVA, F (3, 86) = 57.98, $p < 0.05$, was obtained on the prenatal biochemistry values. A group by first/last day interaction effect showed that the massage therapy group experienced the following effects: (1) increased serotonin levels, F (4, 56) = 2.42, $p < 0.05$; (2) decreased cortisol levels, F (4, 56) = 3.22, $p < 0.05$; (3) increased dopamine levels, F (4, 56) = 4.01, $p < 0.05$; and (4) decreased norepinephrine levels, F (4, 56) = 2.40, $p < 0.05$. These results confirmed the directional changes in biochemistry predicted in Figure 1.

Depression and anxiety

A significant group by pre-post session MANOVA, F (3, 114) = 83.28; $p < 0.001$, was obtained on the self-report measures of depression and anxiety and back and leg pain. Because of the associated decrease in serotonin (5HIAA), it is not surprising that a group by first/last day interaction effect, F (3, 66) = 24.32, $p < 0.001$, showed that the massage group experienced a greater decrease in depression on the CES-D and on the Profile of Mood States. A group by day by pre-post session interaction effect, F (3,71) = 24.32, $p < 0.001$, followed by *t*-tests revealed a greater improvement in mood from pre- to post-session for the massage therapy group on the first and last days of the study, compared to the other two groups (see Table 2). A group by pre-post session interaction effect, F (3, 71) = 14.05, $p < 0.001$, and subsequent *t*-tests revealed a greater decrease in anxiety after the first and last sessions for the massage therapy group (see Table 2). Again, these findings are consistent with the model proposed in Figure 1.

Fetal activity

A significant group by days MANOVA, F (3, 114) = 31.02; $p < 0.001$, was also obtained on the longer-term measures of depression, anxiety, fetal movement, obstetric and postnatal complications. Surprisingly, a first day/last day repeated measures effect, F (3, 65) = 52.08, $p < 0.001$, revealed that all groups showed decreased fetal movement. However, a group by first/last day interaction effect , F (3, 65) = 4.95, $p < 0.005$, showed a

Table 1 Means for maternal prenatal biochemistry on first and last days of the study

Variables	*Massage*		Relaxation		*Depressed control*		*Non-depressed control*	
	First	*Last*	*First*	*Last*	*First*	*Last*	*First*	*Last*
Cortisol $_{ng/ml}$	328.5*	252.2	310.2	294.5	326.0	332.9	271.2	277.0
Norepinephrine $_{ng/ml}$	58.3*	46.1	55.4	46.5	52.9	58.7	41.5	47.5
Dopamine $_{ng/ml}$	242.1*	274.7	252.9	244.3	289.6	267.8	243.9	260.3
Serotonin $_{ng/ml}$	4247.2*	4997.9	3908.6	4284.6	4071.9	4171.9	4822.3	5481.7

*Statistically significant difference between first and last day at $p < 0.05$

Table 2 Means for neonatal variables on first and last days of study

Variables	*Massage*		*Relaxation*		*Depressed control*		*Non-depressed control*	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Immediate effects								
Anxiety (STAI)								
First day	37.4*	26.8	45.5	37.5	36.4	34.7	30.3	29.6
Last day	42.0*	29.5	44.6	35.4	39.4	36.3	31.4	30.2
Mood (POMS)								
First day	8.4*	2.2	9.2	7.4	8.5	7.9	3.1	2.4
Last day	8.2*	2.5	9.6	7.3	8.7	9.7	1.5	0.9
Leg pain								
First day	3.1*	0.9	2.6*	1.7	2.9	2.8	1.4	1.5
Last day	3.6*	2.0	3.6	2.6	2.3	2.2	2.3	2.3
Back pain								
First day	3.5*	0.8	3.9	3.5	2.3	2.2	1.7	1.7
Last day	2.9*	2.0	4.0	3.5	2.6	2.4	1.7	1.8
Longer-term effects	*First*	*Last*	*First*	*Last*	*First*	*Last*	*First*	*Last*
CES-D	24.9*	19.9	26.2	24.8	28.3	27.8	6.5	8.1
Fetal movement (%)	10.2*	1.9	7.9	2.7	7.8	3.5	9.8	3.4
Obstetric comp.**	102.1		91.2		78.0		105.3	
Postnatal comp.**	134.9		134.7		113.8		149.4	

*Statistically significant differences between pre and post measures at $p < 0.05$; **Higher scores are optimal

greater decrease in fetal activity for the massage group.

Obstetric and postnatal complications scale scores and birth measures (see Table 1)

Group main effects suggested that the massage group had better obstetric complications scale scores, F (3, 51) = 4.01, $p < 0.01$, and both the massage therapy and the muscle relaxation groups had better postpartum complications scale scores, F (3, 51) = 2.75, $p < 0.05$. The factors contributing to the better obstetric complication scores were a lesser incidence of prematurity and low birthweight in the massaged group.

Leg and back pain

The increase in serotonin levels may have contributed to decreased leg and back pain. A group by pre-post session interaction effect was obtained on the VITAS-back pain scale, F (3, 66) = 24.32, $p < 0.001$, and a group by pre-post session by day interaction effect was found for the VITAS-leg pain scale, F (3, 70) = 49.20, $p < 0.001$. Bonferroni t-tests revealed decreased back pain for the massage therapy group immediately following the first and last sessions and lessened leg pain for the massage and relaxation groups from pre-to-post session on the first day and only for the massage therapy group on the last day (see Table 2).

Brazelton Neonatal Behavior Assessment Scale (see Table 3)

The lesser incidence of prematurity and low birthweight in the massage group may have contributed to massaged neonates' more optimal performance on the Brazelton Scale. ANOVAS and posthoc Bonferroni t-tests on the Brazelton Neonatal Behavior Assessment Scale scores yielded the following: (1) the neonates of the women in the massage therapy group received better scores than the control group on the habituation, $t = 2.84$, $p < 0.05$, range of state, $t = 1.98$, $p < 0.05$, autonomic stability, $t = 1.92$, $p < 0.05$, and withdrawal scales, $t = 1.91$, $p < 0.05$; (2) the neonates of the women in the massage therapy group received better scores than both the muscle relaxation, $t = 1.75$, $p < 0.05$, and control groups, $t = 2.92$, $p < 0.005$, on the depressed scale; and (3) the neonates of the women in the massage therapy, $t = 1.98$, $p < 0.05$, and relaxation groups, $t = 2.22$, $p < 0.05$, received better scores than the control group on the motor maturity scale (see Table 3 for mean scores).

DISCUSSION

Several hypotheses of this study were supported by the data. Based on findings from our earlier pregnancy massage study[12], stress hormones were expected to decrease, as were

Table 3 Means for postnatal variables

	Massage	*Relaxation*	*Depressed control*	*Non-depressed control*
Brazelton				
Habituation	6.4	5.3	4.4	5.7
Orientation	4.1	4.5	3.5	4.9
Motor maturity	4.3	4.4	3.2	5.1
Range of state	3.7	3.4	3.0	3.9
State regulation	4.5	4.7	4.2	4.8
Autonomic stability	6.2	5.9	5.1	6.7
Abnormal reflexes*	2.7	4.0	2.5	3.2
Withdrawal*	2.7	3.0	4.1	2.2
Excitability*	2.3	2.1	2.1	2.7
Depressed*	3.6	4.4	5.8	2.6

*Lower scores are optimal. See text for statistically significant differences

stress mood states including depression and anxiety. In the proposed model, massage therapy was hypothesized to result in increased serotonin (5HIAA) and dopamine. This hypothesis was derived from massage therapy effects data from several other studies[25]. Serotonin was expected to decrease depression and cortisol, which in turn would be expected to decrease the incidence of premature delivery[6,12]. The increased serotonin and decreased cortisol may have contributed to the better neonatal outcome in this study, providing support for the left pathway of the proposed model. Elevated serotonin (5HIAA) may have also contributed to the reduced leg and back pain, as serotonin is noted to decrease substance P and other pain-causing chemicals[26].

Massage therapy also contributed to increased dopamine which has been noted to dampen norepinephrine levels. Norepinephrine and its associated anxiety state[7] decreased (as was hypothesized in the right pathway of the proposed model). These, in turn, may have also decreased obstetric complications (prematurity and low birthweight). Dopamine may have reduced other related obstetric complications, as it has been shown to improve renal function[27] and urine output in postpartum women with high blood pressure[28], suggesting that increased dopamine may have some clinical significance for specific pregnancy problems, such as pre-eclampsia. Reduced fetal activity may have also resulted from reduced anxiety and stress hormones[27].

Unfortunately, although these data provide empirical evidence for the effects noted in the proposed model, our sample was too small to conduct path analysis to test the relative significance of the pathways. Other limitations of the study include the reliance on subjective self-reports and deriving obstetric and postnatal complications data from medical records, which are often inaccurate. Further, a better design would have been a comparison of different forms or intensities of massage. However, we found that it was too difficult to control or monitor different types or pressure massages when they were conducted by significant others. Also, although the relaxation group may have been less compliant, the group differences favoring the massage group suggest that at least the significant others were compliant in providing massages. Nonetheless, these data confirm and extend our previous study results[12]. Overall, the findings suggest that massage therapy is effective for reducing pregnant women's stress hormones, stressful mood states, leg and back pain and for lessening obstetric and postnatal complications, hence improving neonatal outcomes. They also suggest the efficacy of using a significant other as massage therapist. Further research is needed to explore the underlying mechanisms for these changes.

ACKNOWLEDGEMENTS

We would like to thank the participants, the volunteer massage therapists and the research assistants who helped with this study. This research was supported by an NIMH Merit Award (#MH46586) and NIMH Research Scientist Award (#MH00331) to Tiffany Field and a grant from Johnson & Johnson to the Touch Research Institutes. Correspondence and requests for reprints should be sent to Tiffany Field, Touch Research Institutes, University of Miami

School of Medicine, P. O. Box 016820 (D-820), Miami, FL 33101.

REFERENCES

1. Field T. Maternal depression effects on infants and early interventions. *Prev Med* 1998;27: 200–3
2. Lundy B, Jones N, Field T, *et al*. Prenatal depression effects on neonates. *Infant Behav Dev* 1999;22:119–29
3. Jones N, Field T, Fox N, *et al*. EEG activation in one-month-old infants of depressed mothers. *Dev Psychopathol* 1997;9:491–505
4. Arck PC, Merali FS, Manuel J, *et al*. Stress-triggered abortion: inhibition of protective suppression and promotion of tumor necrosis factor-alpha (TNF alpha) release as a mechanism triggering resorptions in mice. *Am J Reprod Immunol* 1995;33:74–80
5. Paarlberg K, Vingerhoets A, Passchier J, *et al*. Psychosocial factors and pregnancy outcome: A review with emphasis on methodological issues. *J Psychosom Res* 1995;39:563–95
6. Wadhwa P, Porto M, Garite T, *et al*. Maternal corticotropin-releasing hormone levels in the early third trimester predict length of gestation in human pregnancy. *Am J Obstet Gynecol* 1998;179:1079–85
7. Glover V, Teixeira J, Gitau R, Fisk N. Mechanisms by which maternal mood in pregnancy may affect the fetus. *Contemp Rev Obstet Gynecol* 1999; Sept. 155–160
8. Kurki T, Hiilesmaa V, Raitasalo R, *et al*. Depression and anxiety in early pregnancy and risk for pre-eclampsia. *Obstet Gynecol* 2000;95:487–90
9. Hellin K, Waller G. Mothers' mood and infant feeding: prediction of problems and practices. *J Reprod Infant Psychol* 1992;10:39–51
10. Field T, Hernandez-Reif M, Taylor S, *et al*. Labor pain is reduced by massage therapy. *J Psychosom Obstet Gynecol* 1997;18:286–91
11. Field T, Grizzle N, Scafidi F, *et al*. Massage and relaxation therapies' effects on depressed adolescent mothers. *Adolescence* 1996;31:903–11
12. Field T, Hernandez-Reif M, Hart S, *et al*. Pregnant women benefit from massage therapy. *J Psychosom Obstet Gynecol* 1999;20:31–8
13. Field T, Diego M, Dieter J, *et al*. Prenatal depression effects on the fetus and the newborn. *Infant Behavior and Development* 2004;27:216–229
14. Brazelton TB. *Neonatal Behavior Assessment Scale*. Philadelphia: Lippincott, 1984
15. Lundy BL, Jones NA, Field T, *et al*. Prenatal depression effects on neonates. *Infant Behav Dev* 1999;22:121–37
16. Wadhwa PD, Porto M, Garite TJ, *et al*. Maternal corticotropin-releasing hormone levels in the early third trimester predict length of gestation in human pregnancy. *Am J Obstet Gynecol* 1998;179:1079–85
17. Spielberger CD, Gorsuch RC, Lushene RE. *The State Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press, 1970
18. McNair DM, Lorr M, Droppleman LF. *Poms–Profile of Mood States*. San Diego, CA: Educational and Industrial Testing Service, 1971
19. VITAS Healthcare Corporation , 1993
20. Radloff L. The CES-D scale: A self-report depression scale for research in the general population. *Appl Psychol Measure* 1977;1:385–401
21. Dieter JNI., Field T, Hernandez-Reif M, *et al*. Maternal depression and increased fetal activity. *Obstetrics* 2001;21:468–73
22. Littman D, Parmelee A. Medical correlates of infant development. *Pediatrics* 1978;61:470–82
23. Lester BM, Als H, Brazelton TB. Regional obstetric anesthesia in newborn behavior: A reanalysis toward synergistic effects. *Child Dev* 1982;53:687–92
24. Lester B, Tronick E. Neurodevelopmental battery. Unpublished scale. 1992
25. Field T. Massage therapy effects. *Am Psychol* 1998;53:1270–81
26. Moldofsky H. Rheumatic pain modulation syndrome: the interrelationships between sleep, central nervous system, serotonin, and pain. *Adv Neurology* 1982;33:51–7
27. Nasu K, Yoshimatsu J, Anai T, *et al*. Low-dose dopamine in treating acute renal failure caused by preeclampsia. *Gynecologic Obstet Invest* 1996;42:140–1
28. Mantel GD, Makin JD. Low dose dopamine in postpartum pre-eclamptic women with oliguria: a double-blind, placebo controlled, randomised trial. *Br J Obstet Gynaecol* 1997;104:1180–3

Current knowledge on this subject

- Massage therapy improves pregnancy and neonatal outcomes for non-depressed women

What this study adds

- Massage therapy conducted by significant others improves pregnancy and neonatal outcomes for depressed women.