Relaxation Training and Breast Milk Secretory IgA

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Objective: To evaluate the hypothesis that breast-feeding women who participate in relaxation training will have increased secretory IgA (sIgA) levels in their breast milk compared with women not receiving training.

Design: Nonrandomized control trial of a convenience sample.

Setting: Women were recruited from the postpartum floor of a university teaching hospital. The intervention took place in the women’s homes.

Participants: Women in the first 48 hours after delivery who were planning to breast-feed their healthy newborn infants for at least 8 weeks were approached for enrollment. Women were excluded if they had previous experience with relaxation training. At 4 to 6 weeks postpartum, we enrolled 38 women still breast-feeding their infants.

Interventions: Women were allocated into 3 groups. Women in group 1 were taught relaxation and had breast milk samples collected before and after the teaching. Women in group 2 had conversation with similar breast milk sample collection, and women in group 3 had 1 breast milk sample collected. Women in group 1 were encouraged to practice the relaxation once or twice a day for 2 weeks, and a second visit was made to all mothers with repeated breast milk collections. Women who were still breast-feeding at 6 to 8 weeks after study end had a final breast milk sample collected. Breast milk was analyzed for secretory IgA levels. Stress was assayed using the Symptom Checklist-90-R and open-ended questions.

Results: There was no difference in sIgA levels among the 3 groups at any time. Women who reported stress present between visit 1 and visit 2 increased their sIgA levels at the final sample collection (+0.16 g/L) compared with women who reported no stress (−0.09 g/L; P = .03). The ratings of success in relaxation in women in group 1 were related to the following sIgA levels in sample 4: poor relaxation, 0.67 g/L; fair relaxation, 0.41 g/L; good relaxation, 0.35 g/L; and very good, 0.30 g/L (P = .006).

Conclusions: Self-reported stress appears to increase breast milk sIgA levels. Success at relaxation was inversely related to sIgA levels in the group learning relaxation.


Editor’s Note: It seems to be true that stress stimulates sIgA levels in breast milk. Take heart; all that stress just might be good for us—or is it only a protective mechanism for nursing infants?

Catherine D. DeAngelis, MD

Breast-feeding is recognized around the world as the optimum method of infant feeding. It has numerous advantages in promoting the health, development, and psychological outcomes of children. Documented benefits of breast-feeding include decreased instances of wheezing-associated illnesses, decreased ear infections, and other infectious diseases, decreased development of allergies, increased maternal-infant bonding, and improved intellectual development.

Breast-feeding provides important protections from infectious diseases for infants in the developed and developing worlds. One mechanism of this protection is the effect of the immunologic components of breast milk on the infant. These immunologically important substances include the immunoglobulins, lysozyme, lactoferrins, macrophages, Lactobacillus bifidus growth factor, and others. Of the immunoglobulins, IgA is the most prominent. Secretory IgA (sIgA) is found in very high levels in colostrum, which then decline within 4 to 6 weeks postpartum, but sIgA remains present for the duration of lactation.
SUBJECTS AND METHODS

SUBJECTS

This prospective study was approved by the Institutional Review Board of University Hospitals of Cleveland, Cleveland, Ohio. A convenience sample of healthy breastfeeding women, aged 20 to 40 years, delivered of healthy, full-term infants at University Hospitals, was visited within 48 hours of delivery by 1 of the investigators (M.E.O’C.). The investigator explained the study to the new mothers and asked permission to call them 4 to 6 weeks after delivery to determine if they were still breastfeeding and interested in participating in the study. Women whose home addresses were nearest to the hospital were called first. Women were called until the researchers’ slots were filled for the week. The women were assigned to 1 of the following 3 study groups: relaxation intervention (14 women; group 1), attention control (15 women; group 2), and nonintervention control (9 women; group 3). Assignments for a given week were on the basis of availability of the 2 investigators who made the home visits (nonrandomized control trial). One investigator (K.N.O.), skilled in relaxation training, visited all of the group 1 mothers; another (M.E.O’C.) visited all the groups 2 and 3 mothers.

METHODS

At the first home visit, informed consent was obtained, and a baseline sample of 10 mL of breast milk was obtained by breast pump or hand expression. Any mother who did not have a breast pump was given a manual breast pump. Basic demographic questions were answered regarding maternal and infant health, number of children, profession of parents, and breastfeeding supplements. Each mother completed the Symptom Checklist-90-R (SCL-90-R) scale at the first visit. The SCL-90-R is a 90-item self-reported questionnaire designed to reflect psychological symptoms. It includes a global score and subscales of depression and anxiety. Norms exist for healthy women, but not specifically for a postpartum population. Group 1 mothers underwent relaxation training followed by a second breast milk sample collection of 10 mL. During this training, the suggestion was given to mothers to increase breast milk IgA levels. This suggestion was given in a similar manner to all mothers; however, the suggestions to aid relaxation were individualized depending on the preference of each mother. This training was audiotaped. The tape was left with mothers who were asked to listen to the tape twice daily or to perform the relaxation from their memory twice daily. Group 2 mothers had conversation with the investigator for 20 to 25 minutes about hobbies, jobs, infant care, or other issues, followed by a second breast milk sample of 10 mL. Group 3 mothers had no further intervention.

LABORATORY ANALYSIS

Breast milk samples were labeled with a sample number, transported chilled, and then frozen at −20°C. Laboratory personnel were unaware of the identity of the participants and could not associate sample number with the participants.

The IgA concentration in the breast milk was measured using radial immunodiffusion with a commercially available kit (Sanofi Diagnostics Pasteur, Inc, Chaska, Minn) that incorporated standards of known IgA concentration to generate a standard curve for IgA vs diffusion diameter. A calculated correction was made according to the kit instructions to account for the dimeric structure of sIgA, because the standards provided were for monomeric IgA.

DATA ANALYSIS

Data were entered using commercially available software (Epi Info Version 6.0, Centers for Disease Control and Prevention, Atlanta, Ga) and analyzed using 2 commercially available packages (Epi Info Version 6.0 and SPSS for Windows, SPSS Institute, Chicago, Ill). Significance testing was performed using χ² analysis, Student t tests, and analysis of variance.

The stimulus for production of sIgA in breast milk is unclear. Secretion may occur, in part, as a response to past or present maternal infections. In children, secretion of salivary IgA has been shown to be modified through relaxation training that included the suggestion to increase the infection-fighting substances in their saliva. This example of the self-regulation of IgA depends on communication between the nervous and immune systems. Accordingly, research in this area falls into the realm of complementary and alternative medicine. Our hypothesis was that relaxation training and suggestion to breastfeeding women would increase the sIgA levels in their breast milk. Increased levels in breast milk might improve the immunity of breast-fed infants.
RESULTS

Relaxation training was conducted in a comfortable room of the subjects' homes. Although most sessions were conducted in a quiet atmosphere, several were complicated by dogs wandering around the home, cats jumping on the investigator during the sessions, and crying infants. Excerpts from investigators’ notes are included in Table 1.

One hundred six women who were approached while hospitalized agreed to a telephone call at 4 to 6 weeks postpartum. Of the women called, 38 agreed to participate and were enrolled. Major reasons for not wanting to participate when called included returning to work, too busy, and no longer breast-feeding their infant for most feedings.

The demographic information on the women enrolled in the study is listed in Table 2. The only differences among the 3 groups is that group 3 had more mothers insured with Medicaid (P = .006), and group 2 had more women for whom this was their first infant (P = .04). There were no differences in the scores on the SCL-90-R among the 3 groups when analyzed using the General Severity Index (total score) or the Anxiety and Depression subscales (Table 3). The mean scores were all within the normal range for healthy women.2 There was no relationship between whether the mother had older children or previous breast-feeding experience and the presence of stress as defined by the open-ended question.

Table 4 shows the mean slgA levels. There were no differences in the slgA levels among the groups at any of the 5 times tested. During the 2 weeks of the study, 5 of the 14 women in group 1 had practiced the relaxation less than once daily, and 9 had practiced between 1 and 2 times daily. During the second home visit for group 1, relaxation success was evaluated. The slgA levels in group 1 varied with relaxation success. The women rated very good, good, fair, and poor at relaxation had levels of 0.30, 0.35, 0.41, and 0.67 g/L, respectively (P = .006). Women in all groups who reported any stress at the second visit (n = 14) had a significant increase in their slgA level (+0.16 g/L) in the final sample when compared with the women (n = 22) reporting no stress (−0.09 g/L; P = .03). There was no difference in self-reported stress across 3 groups.

At the telephone calls at 6 to 8 weeks after the second visit, 16 women were still using the relaxation techniques by listening to the relaxation tape or practicing relaxation without listening to the tape. Twenty-two women were not using the relaxation at all. This was

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Table 1. Relaxation Training Observations

<table>
<thead>
<tr>
<th>Visit 1</th>
<th>Visit 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>“The subject said she had not had any previous relaxation training. She described excellent visual, auditory, and olfactory imagery. She appeared very relaxed during the training.”</td>
<td>“The subject said she had been practicing about once a day and used the tape 3 times only because the tape recorder broke. She noted that she liked to imagine a beautiful pink color flowing through each of her muscles and relaxing them. I watched her infant lying on the sofa beside her as I guided her through the relaxation review. My impression was that she was very relaxed and comfortable.”</td>
</tr>
<tr>
<td>“The subject held the baby during the relaxation training, which was interrupted several times by her 3-year-old son. The session included progressive relaxation, focusing on a favorite place, suggestions to increase breast milk IgA, and future positive programming about her family. This was tape-recorded and she was given the tape. It was evident that she had not relaxed during this first session.”</td>
<td>“The subject said she has practiced 15 minutes each day and that this effort made her aware just how difficult it is to find 15 minutes in this day for relaxation. She used the tape for each practice. During our practice today a babysitter was with her son. She became very relaxed and, at the conclusion, said she didn’t notice any sounds, including cars on the street outside.”</td>
</tr>
<tr>
<td>“The subject did well during the relaxation training and said she enjoyed it.”</td>
<td>“The subject said she listened to the tape a couple of times and then preferred to do the relaxation practice on her own. She has been practicing daily. When I arrived the baby was a little fussy and in her arms. As soon as she began to do the relaxation he fell soundly asleep and remained asleep during the review period. She also appeared very relaxed.”</td>
</tr>
</tbody>
</table>

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Table 2. Demographic Characteristics of Women

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1 (n = 14)</th>
<th>Group 2 (n = 15)</th>
<th>Group 3 (n = 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD, y</td>
<td>32.4 ± 4.2</td>
<td>29.0 ± 4.1</td>
<td>29.1 ± 4.7</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>11 (78)</td>
<td>14 (93)</td>
<td>8 (89)</td>
</tr>
<tr>
<td>African American</td>
<td>3 (21)</td>
<td>0</td>
<td>1 (11)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school only</td>
<td>0</td>
<td>2 (13)</td>
<td>2 (22)</td>
</tr>
<tr>
<td>Some college</td>
<td>1 (7)</td>
<td>0</td>
<td>2 (22)</td>
</tr>
<tr>
<td>College degree</td>
<td>5 (38)</td>
<td>5 (33)</td>
<td>2 (22)</td>
</tr>
<tr>
<td>Postgraduate degree</td>
<td>7 (50)</td>
<td>8 (53)</td>
<td>3 (33)</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married or living with infant’s father</td>
<td>14 (100)</td>
<td>14 (93)</td>
<td>8 (89)</td>
</tr>
<tr>
<td>Single</td>
<td>0</td>
<td>1 (7)</td>
<td>1 (11)</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>14 (100)</td>
<td>15 (100)</td>
<td>6 (67)$†</td>
</tr>
<tr>
<td>Medicaid</td>
<td>0</td>
<td>0</td>
<td>3 (33)$†</td>
</tr>
<tr>
<td>Worked before pregnancy</td>
<td>12 (86)</td>
<td>15 (100)</td>
<td>7 (78)</td>
</tr>
<tr>
<td>First child</td>
<td>4 (28)</td>
<td>10 (67)</td>
<td>2 (23)$†</td>
</tr>
<tr>
<td>Full breast-feeding</td>
<td>14 (100)</td>
<td>14 (93)</td>
<td>7 (78)</td>
</tr>
</tbody>
</table>

*Unless otherwise indicated, data are given as number (percentage) of mothers. Percentages have been rounded and may not total 100. See the “Subjects” subsection of the “Subjects and Methods” section for a description of the SCL-90-R.

Table 3. Scores on the SCL-90-R

| Mean Scores |
| --- | --- | --- |
| Group 1 (n = 14) | Group 2 (n = 15) | Group 3 (n = 9) |
| General Severity Index, total | 0.29 | 0.40 | 0.35 |
| Anxiety subscale | 0.17 | 0.24 | 0.30 |
| Depression subscale | 0.72 | 0.67 | 0.62 |

*The norms (SD) for healthy women are 0.36 (0.35) for the General Severity Index; 0.37 (0.43) for the Anxiety subscale; and 0.46 (0.52) for the Depression subscale. Higher scores are associated with psychological pathology. SCL-90-R indicates Symptom Checklist-90-R.2
not different among the groups. The sIgA levels in the final breast milk samples from women in each of the intervention groups were not significantly different, nor were there significant differences between those who had and those who had not been using relaxation techniques.

**COMMENT**

**BREAST-FEEDING AND THE IMMUNE SYSTEM**

The decreased incidence of infectious diseases in breastfed infants in the developed world is an important contribution to the health of children. Of the numerous substances present in breast milk that play a role in this, the immunoglobulins are of major importance. Levels of sIgA are much higher than levels of IgG and IgM found in breast milk. Secretory IgA is present in high concentration in colostrum, falls in concentration as the amount of milk produced increases, and reaches a plateau at about 4 to 6 weeks postpartum. Secretory IgA levels remain present for the duration of lactation, although the total amount of sIgA ingested by the infant on a daily basis gradually decreases. Secretory IgA levels in breast milk do not differ between right and left breast or by time of day. The plasma cells in the breast secrete IgA specific to the antigens encountered in the maternal gastrointestinal and respiratory tract systems. This secretion of sIgA into breast milk and its transfer to the infant help to overcome the normal delay in production of immune factors by the infant.

This mechanism has been demonstrated by Fishaut et al, who found increased respiratory syncytial virus (RSV)—specific IgA in breast milk of mothers during the winter (RSV season). One of 2 mothers with culture-proven RSV disease showed an increase in RSV-specific IgA levels in her breast milk in the 3 weeks after infection. Studies of sIgA to *Shigella* antigen in breast milk suggest that the enteromammary system has a long memory, in this case secreting *Shigella*-specific antigens in breast milk in 24% (46%) of 52 Houston, Tex, women. These women had no history of recent *Shigella* infection, and there were no recent *Shigella* outbreaks in Houston during the years before this study.

**IgA AND RELAXATION**

In the 1980s, Olness et al showed that healthy children could increase their salivary IgA secretion after training with relaxation and the suggestion that they increase the infection-fighting substances. The increase in salivary IgA levels was seen immediately after a 20-minute relaxation session. Hewson-Bower replicated these studies in her dissertation, and also examined whether children who practiced relaxation imagery and stress reduction would have fewer upper respiratory tract infections. After an observation period during which each child was monitored for the usual individual frequency of upper respiratory tract infections, she randomized children into experimental (14 weeks of relaxation imagery and stress reduction) and control (14 weeks of attention control) groups. Salivary IgA levels were monitored frequently. Hewson-Bower found increased levels of salivary IgA and a highly significant reduction in the frequency of upper respiratory tract infections for the group that practiced relaxation imagery and stress reduction techniques.

Chronic and acute stresses related to employment have been shown to increase salivary IgA levels in some studies. The amount of increase was not correlated with actual or perceived workload. These results may be attributable to several variables that have an impact on the direction and magnitude of the effects of stress in modulating the immune responses of humans. These variables include intrinsic host factors such as age, sex, genes, amount of sleep, quality and quantity of antigenic stimulation or exposure to infectious agents, and temporal relationship between behavioral and antigenic stimulation. Boyce et al studied the effects of stressors on the immune responses of children. They concluded that some children manifest an intrinsic high immune reactivity and others a low reactivity, and that health effects of psychologically stressful events are best predicted by an interaction between the intensity of environmental stressors and the immunologic biological reactivity of the individual host. Only a subset of people within any given population may be truly at risk under conditions of environmental stress and adversity.

**STRESS, BREAST MILK, AND sIgA**

Stress and fatigue can have an effect on maternal breast milk production. There are numerous anecdotal instances of women facing acute stress with a sudden decrease in their milk production. The mechanism of this—whether it is an effect on prolactin, oxytocin, or other hormones—is unclear.

Groer et al evaluated levels of cortisol and sIgA levels in maternal breast milk in an attempt to associate stress with breast-feeding outcomes. They found that levels of cortisol (a physiologic marker of stress) and sIgA were inversely related, ie, higher stress as measured by increased cortisol levels was correlated with decreased sIgA levels in breast milk. They hypothesized that cortisol may suppress the immunoglobulin production by plasma cells in the breast. This is opposite to the relationship that we found between self-reported stress

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**Table 4. Mean Values for sIgA Levels**

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Group 1 (n = 14)</th>
<th>Group 2 (n = 15)</th>
<th>Group 3 (n = 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.35 ± 0.07 (12)</td>
<td>0.37 ± 0.08 (15)</td>
<td>0.38 ± 0.07 (9)</td>
</tr>
<tr>
<td>2</td>
<td>0.34 ± 0.08 (14)</td>
<td>0.38 ± 0.05 (19)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.32 ± 0.04 (13)</td>
<td>0.36 ± 0.06 (15)</td>
<td>0.35 ± 0.05 (8)</td>
</tr>
<tr>
<td>4</td>
<td>0.37 ± 0.11 (13)</td>
<td>0.38 ± 0.08 (15)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.47 ± 0.29 (10)</td>
<td>0.33 ± 0.05 (9)</td>
<td>0.49 ± 0.42 (5)</td>
</tr>
</tbody>
</table>

*Collection of samples is described in the “Methods” subsection of the “Subjects and Methods” section of the text. Group 3 mothers did not collect samples 2 and 4. sIgA indicates secretory IgA.
*Numbers in parentheses indicate number of mothers providing samples.
and sIgA levels in the final sample. In a small group of 17 mothers, Dillon and Totten found no relationship between levels of salivary IgA and sIgA in breast milk. Using multiple regression models, they found that infant upper respiratory tract infection was related to the mother’s salivary IgA level, age, maternal upper respiratory tract infections, and coping humor. There are few other data on the relationships in postpartum women between levels of salivary and breast milk IgA and stress.

In our study, the lack of effect of relaxation on sIgA levels in maternal breast milk may have been related to improper timing of the breast milk collection. Breast milk collection time was modeled on data for salivary IgA. However, breast milk sIgA may be produced much more slowly and may have needed to be measured during the 2 1/2 to 3 hours after relaxation. Success at relaxation was found to be inversely related to sIgA levels. However, the numbers of women in this section of the study are very small.

It is generally agreed that adults require about 2 months of daily practice to become proficient in self-conditioning relaxation. An example is the standard 9 weeks of training for 30 minutes a day that is provided to Swedish athletes competing in the winter biathlon, who are trained to relax quickly and to reduce their heart rates. Nonetheless, during coaching in relaxation, most adults will demonstrate physiologic changes such as reduced pulse rate, increased peripheral temperature, or reduced electrodermal activity. One third of the women in our study practiced the relaxation technique less than once a day. It is likely that they would have benefited from longer and more frequent practice sessions. One half of the mothers reported months later that they had continued the practice and found themselves increasingly proficient in achieving rapid relaxation during periods of stress.

Our subjects clearly varied in their mental imagery preferences. Some described excellent visual imagery, whereas others preferred auditory or olfactory imagery. Inasmuch as we attempted to use the same relaxation coaching for each subject, we did not allow sufficiently for individual differences and preferences as one would in a typical clinical situation.

Our study showed an effect of self-reported stress on sIgA levels in breast milk at final collection. Mothers who were stressed at the second visit may have continued to be stressed through the final sample collection 6 to 8 weeks later, although we did not measure this. This may have accounted for the increased sIgA levels in the final sample. This would be consistent with data seen in stressed employees studied by Kugler et al and Zeier et al. However, stress as measured by the SCL-90-R did not correlate with the sIgA levels in human milk. The SCL-90-R may not be a good measure of postpartum stress. There are no norms for postpartum women.

Self-reported stress was evaluated at visit 2 by asking the opened-ended question, “Has anything stressful happened to you in the past 2 weeks (between visit 1 and visit 2)?” This resulted in a myriad of answers, including surgery, relatives visiting, relatives leaving, husbands gone, and illnesses. This was coded as any stress present or no stress present. This may have been a better measure of stress than a questionnaire with preset questions. The changes in sIgA levels associated with stress were not seen at the time of the second visit, but 6 to 8 weeks later. Stressed mothers may transfer more immunologically active substances to their infants.

Although there are advantages to conducting a study involving breast milk sampling in the home, it is not possible to control for environmental factors as one might in a research study unit. Nonetheless, some of the environmental factors, ie, dogs, cats, and active toddlers, were more disconcerting to the investigators than to the subjects.

The increased breast milk IgA levels in subjects not practicing relaxation is paradoxical, yet consistent with other studies of humoral immunity and stress. Kiecolt-Glaser and Glaser have noted that higher antibody titers to herpesviruses, ie, Epstein-Barr virus and cytomegalovirus, appear to reflect poorer cellular immune system control of herpesvirus latency. In a study of 45 geriatric residents randomly assigned to relaxation, to participation in social contact, or to no intervention, subjects in the relaxation group showed a statistically significant decrease in herpesvirus antibody titers. This was interpreted as an enhanced ability of the immune system to control viral replication. Our results may reflect increased subclinical infection and the efforts of the immune system to resist this infection via increased antibody production. In subjects practicing relaxation, reduction of stress may be associated with less subclinical infection, less antibody production, and lower IgA levels. In children, evidence of individual differences in immune reactivity exists. Inasmuch as we did not select or assign subjects on the basis of immune reactivity, this variable could also explain observed differences.

The ideal system for the study of immunomodulation does not exist. To move toward a clinical intervention that is practical, research would benefit from a biofeedback system capable of providing minute-to-minute evidence of immune status. For example, humoral immunomodulation research would be more meaningful if there were techniques for monitoring the amount of various immunoglobulins in saliva, tears, or breast milk minute to minute.

**CONCLUSIONS**

Our research presents some intriguing data on the relationship between stress and sIgA levels in breast milk. Some of the data are very consistent with previous work on the effect of stress and the immune system. Because our study is small, it needs to be replicated in a larger group of women with better measures of stress and with collections of breast milk at varying times.

In US culture, the first several months after childbirth are recognized as times of fatigue and stress for the mother. It is important to continue studies to understand how maternal stress affects breast milk production, quality of breast milk, duration of breast-feeding, and infant growth and development.
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REFERENCES