

# Women's Health *REPORT*

A QUARTERLY PUBLICATION OF WOMEN'S HEALTH DIETETIC PRACTICE GROUP

## UNDERSTANDING MENTAL HEALTH ISSUES IN NUTRITION COUNSELING: A CLIENT CENTERED APPROACH **By Daniel Wagner, PsyD and Miryam Rotkowitz, MA, RD**

### Introduction: An Overview of Mental Illness Prevalence and Gender Disparities

According to the World Health Organization, the prevalence of psychological disorders is greater than previously assumed, and rates appear to be on the rise. It is currently estimated that over the course of the lifetime, nearly half of the world's population will be affected by mental illness. At the same time, mental illness is chronically underdiagnosed and undertreated. Among those meeting diagnostic criteria for a psychological disorder, fewer than half receive a diagnosis; fewer still – approximately 2 in 5 patients – seek help for mood, anxiety, or substance abuse symptoms in the first year of symptom onset (1).

Also concerning are significant gender disparities in mental health. Scientists now understand that women are disproportionately impacted by certain disorders, and that symptoms of a particular mental illness may vary between affected men and women. Pregnancy and the postpartum period can be confounding factors, whether due to biochemical and/or emotional triggers for new onset mental illness or changes in symptomatology and/or severity in previously diagnosed mental illness.

While men seeking mental health care tend to consult with a mental health specialist, women are more likely than men to disclose mental health concerns to, and receive treatment from, their primary care physicians. Women are likewise more likely than men to be prescribed psychotropic medications, and to comply with their use (1).

### The Dietitian As Mental Health Gatekeeper

It is important to note then, that patients with prescriptions for antidepressants or other psychotropic medications may not be receiving psychotherapeutic counseling or other support from a mental health specialist. Kravitz et al. found that family physicians and general internists who felt confident in their ability to manage antidepressant therapy – despite lack of training in psychotherapy – were less likely to refer depressed patients to a mental health specialist (2).

presenting with depression, Geraghty, Franks, and Kravitz found that while longer visit length was significantly associated with patient satisfaction, there was wide variability in the amount of time primary care physicians spent with patients, with a mean visit time of 22.3 minutes (3). Since registered dietitians (RDs) in the outpatient or private practice setting typically devote a greater amount of time to each nutrition counseling session, patients may disclose health concerns or raise questions they feel unable to discuss with their doctors. Dietitians, then, may be the “gatekeepers”; who identify patients who could benefit from referral to a qualified mental health specialist.

Physical and mental illnesses have been historically conceptualized as belonging to separate disciplines. Having had training primarily in the former, RDs may feel ill equipped to aid patients or clients presenting with suspected or diagnosed psychiatric comorbidities. It is the goal of this article to shed light on two major disorders with a high rate of prevalence among women, and to offer insight into how the RD might use knowledge of and sensitivity to the challenges of these and other mental illnesses to inform nutrition recommendations for this population.

### The Personality Disorders: Focus on Borderline Personality Disorder and ED Comorbidity

According to The Diagnostic and Statistical Manual of Mental Disorders, 4th ed., (4), personality disorders are characterized by patterns of character traits and behavior that are pervasive and enduring and have onset at adolescence or early adulthood. These patterns are typically inflexible and remain stable over time, and they lead to distress or impairment. In order to be considered a personality disorder, the maladaptive and impairing pattern of behavior must not be due to a manifestation or consequence of another mental disorder (e.g., a mood disorder or an anxiety disorder), and not due to the effects of a substance such as an illegal drug or medication. These patterns of behavior and inner experience (e.g., emotion regulation, impulse control, interpersonal functioning) are generally described as “personality traits.” The descriptor “that’s just the way she is” may be an accurate way of characterizing one with a personality disorder. Consequently, treatments for personality disorders typically aim to help the individual “live with” his or her disorder. Psychopharmacological and psychotherapeutic interventions have been typically used to address symptoms of anxiety and depression resulting from navigating through the world with a personality disorder. However, there are no medications designed to ameliorate the broad range of symptoms and problems

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In addition, in a study conducted with standardized patients

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## from the chair Denise Andersen, MS, RD, LD, CLC

The American Dietetic Association's (ADA) Food & Nutrition Conference & Expo (FNCE) in Denver was rewarding and educational. I had the opportunity to meet many members of our DPG that have assisted over the years in the growth and development of our DPG and the field of women's health more broadly.

It was exciting to be a part of FNCE and to see many of you at the various events; from member networking forums to the DPG showcase and educational breakouts. The opening session was both educational and dynamic as we were provided with a glimpse of what's to come in the next year at ADA. As always, FNCE is a great place to learn about the latest research, share in the wealth of knowledge that our colleagues bring from so many diverse fields and re-energize our focus and practice by taking advantage of networking opportunities with those who may one day become collaborative partners. In addition, the Member Showcase was a great success and we gained new members for our ranks.

This year we partnered with the Nutrition Education of the Public (NEP) DPG and the Medical Nutrition Practice Group (MNP) DPG for our annual networking breakfast. The turnout was tremendous as over 100 members from the three DPG's attended the event. Carolyn O'Neill formerly from CNN and the Food Network was the keynote speaker who presented valuable information regarding digestive health. The networking event was sponsored by SunSweet Growers. All attendees were provided with take home samples of dried plums and Plum Sweet.

This year the Women's Health Dietetic Practice Group will have many exciting events for members. The most tangible connection for our members is our quarterly newsletter, the *Women's Health Report*, and the WH EML. Building on last year's great success, our first teleseminar of the year was presented to our members by Jeanne Blankenship MS, RD, CLE. Her presentation entitled *Bariatric Surgery: Implications for Nutrition during Pregnancy and Lactation* was well received. We'll keep you informed on more to come!

**The Women's Health Report** (ISSN-3233) is a quarterly publication of the Women's Health Dietetic Practice Group (WH DPG) of the American Dietetic Association. The WH Report features articles, as well as information on programs, materials, positions, and products for use of its readers. News of members, book reviews, announcements of future meetings, requests for information, or other items of interest to women and reproductive nutrition dietetics practitioners should be sent to the Newsletter Editor by the next published deadline date.

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## from the editor Olivia Eisner, MPH, RD, IBCLC

How appropriate that the theme of this season's newsletter is Mental Health! As the days get shorter and the joys (and stresses) of the holiday season approach there is much to be thankful for and much to send one straight to bed vowing to emerge again only when the crocuses do. With our new economic climate, and our workplaces pushing all of us to do more with less it is no wonder mental health is such a big issue. In this issue, our dear Communication Chair, Miri Rotkowitz, MA, RD shows true partnership with her husband Daniel Wagner, PsyD in crafting a timely and ever-important piece on how mental health affects all health care providers and the ways in which RDs need to understand and be able to respond to ALL the needs of our patients.

On a similar theme, we present an article from Kathleen Kendall-Tackett, PhD, IBCLC who explores depression in breastfeeding mothers and the new inflammation paradigm. In addition, you will find a recap of this year's FNCE events and what's going on in the Women's Health DPG. To be sure we have a fantastic group of professionals moving the line forward and the bar higher when it comes to women's health issues.

So to save my mental health for the next few months I've vowed to take my Vitamin D capsules everyday, get outside for some fresh air no matter how cold, bust out the crockpot for easy weeknight comfort meals and plan fun evenings with friends. What's your plan? If you are feeling like getting more involved and broadening your circle of colleagues, co-conspirators and friends... please reach out to us. We can certainly find a way for you to put your talents and knowledge to good use!

that can arise from one of these disorders, and there are very few psychotherapy treatments (e.g., Dialectical Behavior Therapy for Borderline Personality Disorder) (5) that have been empirically validated and are comprehensive enough to address the full scope of a personality disorder.

Personality disorders present challenges to healthcare practitioners in all disciplines. The inflexible and persistent maladaptive patterns of behavior in people with these disorders can result in limited acceptance of the professional relationship. For example, a client may refuse to trust the dietitian due to perceived (and frequently imagined) negative interpersonal cues stemming simply from the professional's manner of dress or tone of voice. An individual with a personality disorder will often reject any change to her established life routines. Consequently, a dietitian may encounter compromised success in the implementation of a new diet for this individual. One of the most common and well known of the personality disorders is Borderline Personality Disorder (BPD), which is diagnosed predominantly in females.

Borderline Personality Disorder has been of considerable clinical and theoretical interest for decades. Torgerson, Kringlen and Cramer found BPD to have a community prevalence of nearly 1% (6). In a review of systematic studies, Widiger and Frances estimated that 11% of all psychiatric outpatients and 19% of all inpatients meet diagnostic criteria for BPD (7). According to Skodol and Oldham, borderline personality disorder may account for one-third of all outpatient diagnoses of personality disorder and almost two-thirds of all such inpatient diagnoses. Skodol and Oldham also report varying estimates, ranging from 0.2% to 15% for the prevalence of the disorder in the non-diagnosed community (8). BPD is associated with a high degree of functional impairment (9). The symptom of BPD that likely makes the greatest demand on mental health resources is recurrent suicidal threats and gestures, and some clinicians consider it a defining characteristic of the disorder (10). In addition, suicidal thoughts are nearly universal in these patients (9), and non-suicidal self-injury also occurs frequently (5). Moreover, the anger and interpersonal difficulties associated with the disorder further pose challenges for the therapeutic relationship.

Borderline Personality Disorder presents many challenges to mental health practitioners, as the disorder is difficult to diagnose and treat, and may interfere with the treatment of other disorders. Currently, The Diagnostic and Statistical Manual of Mental Disorders 4th ed., describes borderline personality disorder as an Axis II personality disorder characterized by a pervasive pattern of instability of interpersonal relationships, self-image, and affects, and marked impulsivity beginning by early adulthood (4). That is to say, individuals with BPD will generally present with impulsivity, interpersonal chaos, emotion dysregulation, and confusion about self.

People with BPD often exhibit behaviors aimed at avoiding real or imagined abandonment, and these behaviors can be frantic. Mental health practitioners have frequently reported instances in which patients with BPD have called them on the telephone several times during the day when experiencing anxiety, sadness, or anger associated with abandonment. Therapists who take time off from work often must make specific arrangements with their patients with

BPD in order to plan for safety during this time off (e.g., provide patients with the phone number of another therapist; have patients sign a "no-self-harm contract" and to agree to contact the emergency room if they feel at risk for self-harm).

In interpersonal relationships, individuals with BPD typically vacillate between idealization and devaluation of the same person. People with BPD will go from love to hate and then back to love in less than 60 seconds. One day, a client with BPD may barge into a therapist's office and berate her with verbal abuse, and then the following week, this same client may present with infantile affection and neediness toward the therapist. As one may imagine, this unstable and relatively unpredictable vacillation between extremes can cause therapist stress and anxiety, and is among the leading causes of burnout when working with this population.

Along with alternating between extremes of love and hate toward others, individuals with BPD generally demonstrate equally unstable patterns when viewing themselves. A client with BPD can report optimism about the future and view herself as a worthy, lovable person on one day, then on the next day, she may present with severe depression and suicidal ideation due to feeling worthless. The following week, this same person may walk into her therapist's office with a grandiose sense of self.

Unstable and chaotic confusion about self often is an underlying factor for eating disorder behavior in this population. Clients with BPD may engage in restriction or purging behaviors in order to feel like they are "in control" over themselves during acute episodes of confusion. Conversely, these same clients may also binge in order to "fill up" in response to pervasive feelings of emptiness. Eating disorder behavior can be linked to episodes of self-hate, when clients punish themselves, and to episodes of frantic attempts to avoid abandonment (i.e., "I must starve myself in order to be attractive, as nobody loves ugly people."). Restricting and purging may also be associated with deliberate self-harm behaviors in this population. Due to the fact that the underlying causes for these behaviors are both clinically relevant and potentially multifactorial, it is important for dietitians working with clients who have eating disorders to ensure referrals to a mental health practitioner, and to collaborate with the client's mental health counselor to promote optimal care.

In the American Dietetic Association's position statement, "Nutrition Intervention in the Treatment of Anorexia, Bulimia Nervosa, and Other Eating Disorders," the ADA specifies that "working with this population requires advanced level training" because "understanding the complexities of eating disorders, such as influencing factors, comorbid illness, medical and psychological complications, and boundary issues, is critical in the effective treatment of eating disorders." Moreover, interdisciplinary collaboration between psychological, nutritional, and medical specialists is vital. Only credentialed mental health professionals should be providing psychotherapy, yet in order to "support the psychotherapy of choice, it is critical that the RD's messages and communication style (verbal and nonverbal) match the individual's treatment plan," which further recommends the importance of specialized training for the RD (11). As such, if a dietitian lacking this advanced

training encounters a patient or client with a diagnosed or suspected eating disorder, ethical practice dictates that whenever possible, s/he should refer the client to specialists qualified to provide both psychotherapeutic and MNT support to this population. Ideally, in order to promote follow-through, the RD will assist the client in making contact with these specialists, rather than simply instructing such clients to contact the specialists on their own.

### Anxiety Disorders: Focus on Obsessive-Compulsive Disorder

Obsessive-Compulsive Disorder (OCD) is an anxiety disorder that is characterized by obsessions and compulsions that are severe enough to be time consuming or cause marked impairment in functioning. OCD is both extremely common and debilitating – Eisen et al cited that it is the 10th leading cause of disability in the industrialized world, and demonstrated that it has a significant negative impact on quality of life (12). Obsessions are thoughts, images, or ideas that are persistent and cause significant anxiety or distress. These thoughts are not within the individual's control, and they arrive unexpectedly. Also, the individual is able to recognize that these thoughts or images are products of his or her own mind. For example, a person with OCD may experience repeated intrusive thoughts about being contaminated by germs, but she will realize that these thoughts may be irrational or inappropriate. That is, the thoughts are not simply excessive worries about being exposed to illness, nor are they connected to real-life problems. Thoughts about contamination are among the most common obsessions. Other common obsessions are repeated doubts, such as worrying that one has left a water faucet open or a door unlocked, a need to have things in a particular order, aggressive or horrific impulses, and sexual imagery.

People with obsessions usually try to ignore or block their intrusive and uncomfortable thoughts or images, or to neutralize them with some other thought or action. These replacement thoughts or behaviors are called compulsions. People with OCD perform compulsions in order to reduce the anxiety or distress caused by the obsessions. For example, one who struggles with obsessions about contamination may engage in compulsive hand washing. Compulsions are either excessive or are not connected in a realistic way with what they are designed to neutralize or prevent. Washing and cleaning are among the most common compulsions, as are counting, checking, requesting/demanding assurances, and repeating actions.

In OCD, the obsessions and compulsions cause marked distress, are time-consuming, and often significantly interfere with the individual's normal routine, occupational functioning, or usual social relationships or activities with others. People with OCD are often distracted by their obsessions and compulsions, and therefore often struggle with concentrating on tasks such as reading or mathematics. Additionally, people with OCD often avoid situations or objects that provoke obsessions or compulsions. For example, one may refuse to enter a restaurant because she anticipates anxiety and distress if she notices that the silverware on the tables are not arranged perfectly, with knives and forks at parallel lines on either sides of the plates. The individual may struggle with the compulsion to “fix” the silverware on each table, and this compulsion will interfere with her dining experience (and most likely will annoy other diners who are sitting at the “imperfect” tables!). Such avoidance can become extensive and can severely restrict general functioning.

Given the debilitating and distressing nature of obsessions and compulsions, the RD working with a client with OCD should be mindful of nutrition interventions that might lend themselves to promoting obsessive thoughts and/or compulsive behavior. Discussing the dangers of mercury and PCB contamination at length with a pregnant client with OCD might cause undue distress, whereas offering a simple list of fish to avoid, then focusing on safe, Omega-3 rich fish might be a better tactic. Likewise, when offering weight loss counseling to the client with OCD, it may be best to avoid instructions that could lend themselves to repetitive, counting, or checking behaviors, such as counting calories, measuring food portions, or even dividing one's plate and filling half with vegetables, one quarter with protein, and one quarter with grains. Instead, empowering the client to focus on simple, actionable, effective changes, such as replacing at least one soda each day with a glass of water, integrating a vegetable into each meal, or swapping refined grains with whole grains may prove more manageable for the client while still promoting the desired nutrition goals.

### Conclusions

Many dietitians view mental illness as outside the realm of dietetics practice. Yet just as the dietitian considers and researches a patient's medical comorbidities in order to provide optimal care for the presenting problem, it behooves the RD to pursue a deeper understanding of any mental health issues with which a patient or client presents. Ideally, this will result in a greater sensitivity to the challenges the client contends with on a regular basis, and will help the RD provide more effective – and empathetic – nutrition therapy for these clients. While psychotherapy is outside the expertise of the RD, the dietitian may be in a unique position to glean which patients may benefit from psychotherapeutic support, and to build the rapport necessary to successfully refer clients to a qualified mental health specialist. Finally, collaboration with the client's mental health specialist may help promote optimal nutrition care and support.

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# WEIGHT GAIN IN PREGNANCY: HOW MUCH AND WHEN TO GAIN?

By Elizabeth M Ward, MS, RD

## Abstract:

Becoming pregnant at a healthy weight is important to pregnancy outcome. While many women are underweight at the time of conception, more than ever, women of reproductive age are becoming pregnant while overweight or obese. Maternal overweight, as well as inappropriate gestational weight gain for Body Mass Index (BMI), jeopardizes the future health of mothers and their children. To help ameliorate the potential complications from starting pregnancy at an unhealthy BMI and then gaining too little or too much weight, the Institute of Medicine (IOM) recently released guidelines for pregnancy weight gain, the last of which were released in 1990. Registered dietitians and other nutrition and health professionals play a key role in educating women about the effects of preconception body weight on fertility and pregnancy outcome, as well as how much weight to gain, and when, to minimize pregnancy complications and postpartum weight retention.

## The Latest in Pregnancy Weight Gain Guidance

In the nearly two decades since the IOM's 1990 publication, Nutrition During Pregnancy (1), the prevalence of overweight and obesity among American women in their reproductive years has increased across all population groups. Currently, 62% of U.S. women capable of conceiving are overweight, defined in a study by Ogden et al as Body Mass Index (BMI) of >25 kg/m<sup>2</sup>, while 33% are considered obese, with a BMI ≥ 30 kg/m<sup>2</sup> (2).

In the latest guidelines for gestational weight gain, Weight Gain During Pregnancy: Reexamining the Guidelines, the IOM committee operated from the premise that the significance of pregnancy-related weight begins before conception and continues through the first postpartum year. Gestational weight gain recommendations are based on pre-pregnancy BMI (3). Weight Gain During Pregnancy relies on BMI standards devised by the World Health Organization (3); these guidelines differ from those used to categorize BMI in 1990 (1). The criteria for classifying pre-pregnancy weight status are listed in Table 1.

**Table 1: Criteria for Classifications of Pre-pregnancy Weight Status**

	Body Mass Index (kg/m <sup>2</sup> )
Underweight	<18.5
Normal	18.5 - 24.9
Overweight	25.0-29.9
Obese	≥30

Source: IOM

Observational studies suggest that women who enter pregnancy at a normal BMI and gain within the recommended ranges are more likely to have a good birth outcome than those who do not (1). However, no matter their pre-pregnancy BMI, many women gained more or less than recommended according to the 1990 IOM weight guidelines (1), which do not differ much from the 2009 IOM guidelines. Table 2 lists the suggested weight gain for women based on their pre-pregnancy BMI and whether they are having one baby or two.

**Table 2: Suggested Gestational Weight Gain, Singleton and Twin Pregnancy**

If Prepregnancy BMI Is (kg/m <sup>2</sup> )	Gain This Amount (singleton)	Body Mass Index (kg/m <sup>2</sup> )
<18.5	28 to 40 pounds	Ask your doctor*
18.5 - 24.9	25 to 35 pounds	37 to 54 pounds
25.0-29.9	15 to 25 pounds	31 to 50 pounds
≥30	11 to 20 pounds	25 to 42 pounds

Assuming a 1 to 4.4 pound weight gain during the first trimester. \*Insufficient evidence was available to make a determination. Source: IOM

## Pregnancy Weight Gain: Start From a Healthy Place

Achieving and maintaining a healthy BMI helps women in their childbearing years to conceive more easily. Maternal underweight and overweight are associated with menstrual irregularities that delay and prevent conception (4, 5) and women with BMIs outside of the normal range are also less likely to conceive when receiving assisted reproduction treatment (6).

Conceiving at a healthy weight also reduces the chances of pregnancy complications. Pre-pregnancy underweight and inadequate gestational weight gain (7) are associated with increased preterm birth risk. Maternal obesity is linked to increased risk of pregnancies affected by a neural tube defect (NTD) and other structural defects including heart defects, anorectal atresia, hypospadias, limb reduction defects, diaphragmatic hernia, and omphalocele (8,9). Pre-pregnancy BMI between 19.8 kg/m<sup>2</sup> and 26 kg/m<sup>2</sup> is associated with a lower risk of preeclampsia, gestational diabetes (GDM), Cesarean delivery, and failure to initiate and sustain breastfeeding (3). A detailed review of the detrimental influence of maternal overweight and obesity on fertility, pregnancy outcomes, and the health of both mother and child has been recently published elsewhere (10).

Excess gestational weight gain also affects postpartum weight retention, which has implications for maternal health, subsequent pregnancies, and the future health of children. Compared to women who gain less weight, those who gain more during pregnancy are more likely to retain more weight after delivery, and to continue gaining during their lifetime (10). Higher maternal BMI and gestational weight gain have been associated with greater fat mass in infants and subsequent overweight in children (11, 12).

## Encouraging Consistent Weight Gain

Women are often curious about how many additional calories they need during pregnancy. Many are surprised to learn that there is no increased energy requirement during the first trimester of a singleton pregnancy (13), despite the fact that the first trimester is a time of rapid growth and cell differentiation. Women pregnant with twins, however, require an additional 500 calories a day, starting in the first trimester (14).

Calorie needs in a singleton pregnancy increase at the start of the second trimester, and are estimated at an additional 340 kcal/day (13). During the third trimester, suggested calorie intakes are about 450 kcal/day more than pre-pregnancy needs. Energy requirements

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may differ for pregnant obese women. The new IOM weight gain guidelines suggest a specific, relatively narrow range for weight gain (11 to 20 pounds) in women with BMI of  $\geq 30$ , which was lacking in the IOM's 1990 suggested gestational weight gain recommendations (1). There is evidence suggesting that women with BMIs of  $\geq 30$  who gain less than 15 pounds have better pregnancy outcomes, and a lower risk for several complications, including preeclampsia, Cesarean delivery, and GDM (15). Suggested weight gain during the second and third trimesters are based on pre-pregnancy BMI, and are summarized in Table 3.

**Table 3: Suggested Weekly Rate of Weight Gain for Singleton Pregnancies, 2nd and 3rd Trimesters\***

Prepregnancy BMI (kg/m <sup>2</sup> )	Recommended Weight Gain (pounds)	Range (pounds)
<18.5	1	1.0-1.3
18.5 - 24.9	1	0.8-1.0
25.0-29.9	.6	0.5-0.7
$\geq 30$	.5	0.4-0.6

Source: IOM; Calculations assume a 1.1-4.4 lbs weight gain in the first trimester. \* No guidelines were issued for multi-parous women

## The Role of Nutrition Professionals in Promoting Reproductive Health

About 6 million pregnancies occur in the United States each year (16), presenting an opportunity for registered dietitians (RDs) and other nutrition professionals to help improve the reproductive health of women in a variety of health care settings. In fact, the 2009 IOM report suggests that in order to achieve the committee's goals – which include increasing the number of women who conceive at a BMI within the normal range of 18.5 to 24.9 kg/m<sup>2</sup>, encouraging appropriate gestational weight gain based on pre-pregnancy BMI, and eliminating postpartum weight retention – women may need to work with a RD (3).

Body weight is often used as a marker of nutritional status. However, BMI doesn't tell the whole story when it comes to priming the body for pregnancy. While being underweight may reflect chronic nutrient shortfalls that could affect maternal and child health, RDs and other nutrition professionals know that BMI is not always predictive of a woman's health status, ability to conceive, or pregnancy outcome. For example, women with a normal BMI may have dietary patterns that fall short on folic acid and iron, nutrients necessary for optimal fetal development. On the other hand, a woman who has an elevated BMI because of lean muscle mass content may actually be fitter to have a child than a woman with a lower BMI.

Designing balanced eating plans for preconception, pregnancy, and the postpartum period that include adequate folic acid and iron sources, and account for a woman's health history, will help to satisfy the IOM's goals for women in the reproductive years. The MyPyramid Plan for Moms provides dietary guidance for pregnant and lactating women. It accounts for a woman's age, activity level, and trimester of pregnancy. However, the MyPyramid Plan for Moms does not provide guidance for women pregnant with more

than one baby, and it does not adjust suggested calorie levels based on pre-pregnancy BMI, which may be necessary for underweight and overweight women to achieve the IOM's pregnancy weight gain guidelines.

It's important to include recommendations for physical activity into the conversation about reproductive health before and after pregnancy, and to encourage exercise during pregnancy, too. Women with uncomplicated pregnancies should participate in at least 30 minutes of moderate, safe activity on most days of the week (17, 18), with their health care provider's permission. There is some evidence suggesting that moderate physical activity during pregnancy reduces the risk of preeclampsia and GDM by nearly half (10). Once they deliver, most women can begin exercising within a few weeks (18). Along with moderate calorie reduction, increased physical activity may hasten the loss of postpartum weight.

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# A NEW PARADIGM FOR DEPRESSION IN NEW MOTHERS: The central role of inflammation and how breastfeeding and anti-inflammatory treatments protect maternal mental health

*Reprinted with permission from the International Breastfeeding Journal, 2007 2:6*

By Kathleen Kendall-Tackett, PhD, IBCLC

Depression in new mothers is common in many cultures, affecting anywhere from 10% to 20% of postpartum women. In some high-risk populations, the percentage can even be as high as 40% or 50% [1]. Since depression has devastating effects on both mother and baby, it's vital that it be identified and treated promptly. Depressed mothers are also more likely to stop breastfeeding with negative health effects for each [1]. In this paper, I describe a psychoneuroimmunology (PNI) framework for depression in new mothers and discuss its implications for breastfeeding women.

## Inflammation and depression

In recent years, researchers in the field of PNI have found that inflammation is involved in the pathogenesis of depression. Maes and colleagues first documented that mothers with the postpartum blues had higher levels of inflammation than mothers who did not [2]. They concluded that the postpartum blues were caused by an activated inflammatory response system (IRS). In a later paper, Maes and colleagues noted that "it is generally accepted that in the early puerperium, there is an increased inflammatory responsiveness in the serum ... suggesting an activation of the inflammatory response system" [3] (p. 71).

When researchers first identified inflammation as increasing the risk of depression, most considered it an independent risk factor along with several others. The other risk factors included psychosocial stress, a broad category that included significant life changes, lack of social support, marital difficulties, infant illness or prematurity, and low income. Psychological trauma, another risk factor, includes current trauma or a history of trauma, which creates a vulnerability to future stressors even when there are no current symptoms. Sleep disturbance and pain are physical stressors that are common among new mothers and increase the risk of depression. The model portrayed on Figure 1 shows these as individual risk factors and represents the old paradigm.

More recent research, however, suggests a new paradigm for understanding depression. PNI researchers have found that physical and psychosocial stressors (i.e., all the risk factors for depression) increase inflammation [4-6]. These recent studies constitute an important shift in the depression paradigm: inflammation is not simply a risk factor; it is the risk factor that underlies all the others [7]. This model is portrayed on Figure 2.

Puerperal women are especially vulnerable because their inflammation levels rise significantly during the last trimester of pregnancy – a time when they are also at high risk for depression. Moreover, common experiences of new motherhood, such as sleep disturbance, postpartum pain, psychological stress, and trauma also increase inflammation. Physical and psychosocial risk factors for depression are still important to identify. The old paradigm identifies the known causes of depression in new mothers.

The new paradigm moves the field forward and provides an answer to the next question: why? Why would psychosocial risk factors, such as lack of social support or marital strife or stress, increase the risk of depression? Why would depression be more likely in women who are sleep deprived or who have experienced trauma or pain? The new paradigm provides perspective on the mechanism by which previously identified risk factors increase risk. It also guides practitioners in their intervention efforts and suggests that targeting inflammation may increase women's resilience to other stressors.

## Breastfeeding and depression in mothers

Breastfeeding also has an important role to play in mothers' postpartum mental health. Groër and Davis noted that "breastfeeding confers some psychoneuroimmunological benefits to mothers" (p. 599) in part because of its impact on stress [8]. In an earlier review, Groër, Davis and Hemphill noted that although women experience many stressors in the postpartum period, breastfeeding protects them by inducing calm, lessening maternal reactivity to stressors, and increasing nurturing behaviour [9]. The PNI approach is relevant to lactation specialists because it demonstrates that breastfeeding can protect mothers' mental health and is worth preserving whenever possible.

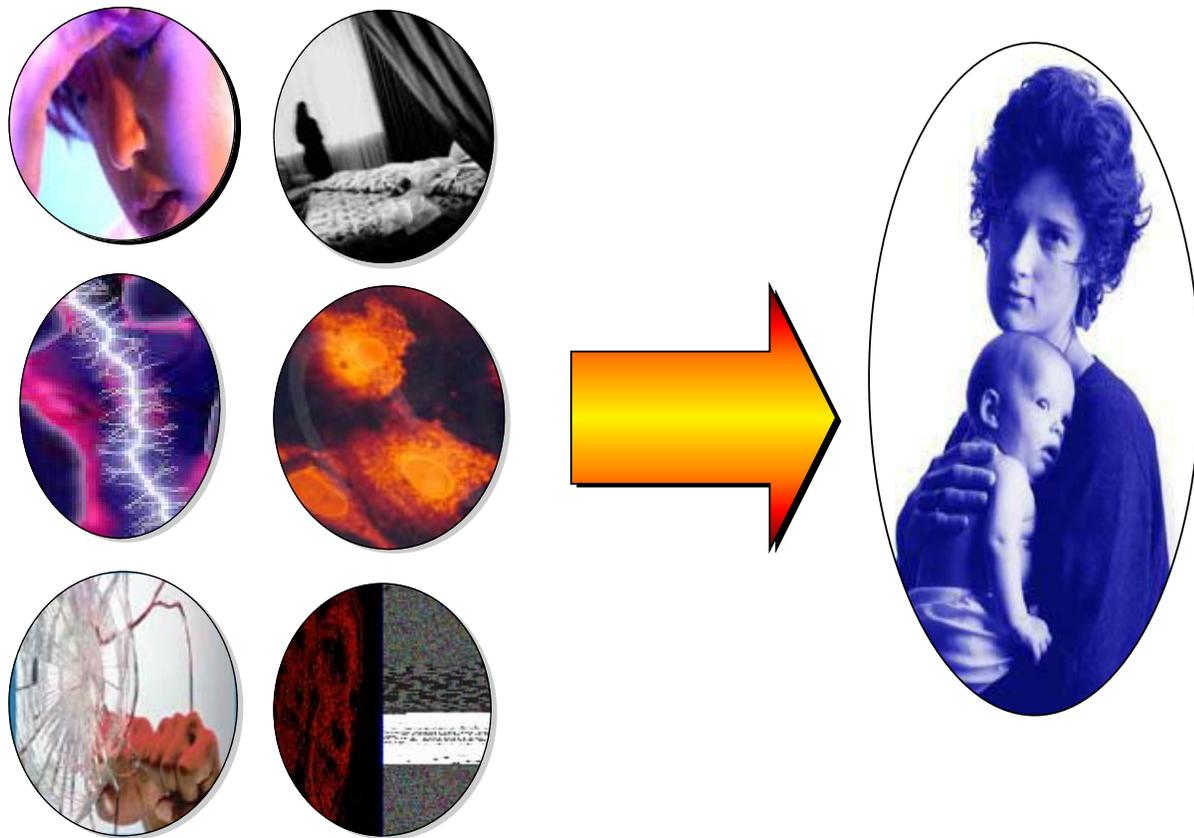
## Method of literature review

The studies cited below were assembled from a wide variety of sources. Literature searches on PubMed and PsychInfo were conducted on depression, postpartum/postnatal depression, depression and inflammation, proinflammatory cytokines, pain, sleep disturbances, HPA dysfunction and depression, trauma, and omega-3 fatty acids. In addition, several key PNI and psychiatry journals were manually searched for relevant articles including *Psychoneuroendocrinology*, *Psychosomatic Medicine*, *Psychosomatic Research*, *Biological Psychiatry*, *Health Psychology*, *American Journal of Psychiatry*, *British Journal of Psychiatry*, and *British Medical Journal*. Where appropriate, literature from the field of cardiovascular medicine was cited as this literature contains many studies that examine the links between depression, inflammation and risk of cardiovascular disease.

## Physical and psychological stressors that increase inflammation and risk of depression

To understand the role of inflammation in depression, it's helpful to first review the normal physiologic response to stress. When faced with a threat, human bodies have a number of interdependent mechanisms in place designed to preserve our lives. The sympathetic nervous system responds by releasing catecholamines (norepinephrine, epinephrine, and dopamine). The hypothalamic-pituitary-adrenal (HPA) axis also responds: the hypothalamus releases corticotrophin releasing hormone (CRH), the

Continued on page 8



**Figure 1**  
**Risk Factors for Depression in New Mothers – Old Paradigm.** Depicts six identified risk factors for depression in new mothers: stress, sleep disturbance, pain, inflammation, psychological trauma, and a history of abuse, depression, or trauma.

pituitary releases adrenocorticotropin hormone (ACTH), and the adrenal cortex releases cortisol, a glucocorticoid. The immune system responds by increasing production of proinflammatory cytokines, which increase inflammation. Cytokines are proteins that regulate immune response. Proinflammatory cytokines help the body heal wounds and fight infection by stimulating an inflammatory response [10].

Maes and colleagues described the interrelatedness of these systems and noted that inflammation influences levels of serotonin and catecholamines, and has an impact on the HPA axis, which controls cortisol levels [7,11]. Once inflammation starts, it triggers the HPA axis to release cortisol, and the release of more proinflammatory

substances [12]. Breastfeeding appears to attenuate these effects by lowering cortisol, ACTH, epinephrine and norepinephrine [8].

*(1) Immune and HPA dysfunction in depression*

Depression is also related to some distinct abnormalities in the immune system and HPA axis. I will describe the immune effects first. For many years, researchers considered depression to be primarily immunosuppressive in that they observed that depressed people had fewer lymphocytes and the natural killer cells (NK) had lower cytotoxicity [6,13]. These are both indications of a suppressed immune system. More recent studies, however, indicate that depression causes an immune dysfunction, meaning that some aspects are suppressed, while other aspects are

# MENTAL HEALTH AND NUTRITION RESEARCH BRIEF

By Megan Tubman, MS, RD

The research studies covered in this brief address the mental health of postpartum women, as well as those who are peri- or post-menopausal. Though the age range is broad, the common theme is that recent research is revealing the strong relationship between nutrition and depression.

## **“Vitamin B6 is associated with depressive symptomatology in Massachusetts elders.”**

*Merete C, Falcon LM, Tucker KL. Vitamin B6 is associated with depressive symptomatology in Massachusetts elders. J Am Coll Nutr. 2008 Jun;27(3):421-7.*

Various vitamin deficiencies have been associated with risk for depression, however Merete and coauthors note the lack of research done on the impact of B6 status on depression, particularly in minority populations, and imply that theirs is one of the first to investigate this area. They conducted a cross-sectional study, assessing B6 intake using a 118 item food frequency questionnaire, plasma pyridoxyl-5'-phosphate (PLP) after a 12-hour fast, and depressive symptoms as assessed using the Center for Epidemiologic Studies Depression Scale, in 618 Hispanic and 251 non-Hispanic white (NHW) elderly (60% female, 40% male) living in Massachusetts. Analysis of data yielded no statistically significant difference between Hispanic and NHW B6 intake and depressive symptomatology,

For the population as a whole, the relationship between dietary B6 and depressive symptoms was found to be significant. However the relationship between total intake of B6 (diet plus supplements) and depressive symptoms was not. There was also a significant relationship between plasma PLP levels and depressive symptoms. PLP <20nmol/L, indicative of low circulating B6, was associated with twice the risk of depression. Authors noted a potential confounder to the relationship between total intake and depressive symptoms could have been supplement use as treatment for depressive symptoms. They conclude that long term studies will be needed to assess the relationship between intake of B6 from food or supplement and depression.

This study is notable because it provided data on a topic that has not been extensively studied, in a minority population and elder age group, as well as showing a statistically significant relationship between nutrient intake and mental health.

## **“Higher dietary intake of long-chain omega-3 polyunsaturated fatty acids is inversely associated with depressive symptoms in women.”**

*Colangelo LA, He K, Whooley MA, Daviglius ML, Liu K. Higher dietary intake of long-chain omega-3 polyunsaturated fatty acids is inversely associated with depressive symptoms in women. Nutrition. 2009 Oct;25(10):1011-9.*

Colangelo and co-authors examined the relationship between fish intake, EPA, DHA and EPA+DHA intake and depression, in a cohort of 3317 African-American and Caucasian individuals (1836 women, 1481 men) aged 32 years +/- 3.6 years. Depressive symptoms were

measured three, eight and ten years after dietary assessment, and these assessments were done using the Center for Epidemiological Studies Depression scale and a 100-item food frequency questionnaire. Researchers found that, in women in the highest quintile of fish intake, depressive symptoms were significantly lower than for those women in the lowest quintile for fish intake. Depressive symptoms were also significantly lower for those in the highest quintile for DHA, EPA, and DHA+EPA intake.

Though the relationship between fish oil intake and decreased incidence of depression is not a new area of study, this article adds to a group of studies now showing a significant effect for females in particular.

## **“Maternal symptoms of stress, depression, and anxiety are related to nonresponsive feeding styles in a statewide sample of WIC participants.”**

*Hurley KM, Black MM, Papas MA, Caulfield LE. Maternal symptoms of stress, depression, and anxiety are related to nonresponsive feeding styles in a statewide sample of WIC participants. J Nutr. 2008 Apr;138(4):799-805. Erratum in: J Nutr. 2008 Oct;138(10):1982. Caulfield, Laura E.*

In a study published last October, Hurley, Black, Papas and Caulfield examined the relationship between maternal mental-health with choice of infant feeding style in a group of 702 mother-infant pairs that were randomly selected from participants in the Maryland WIC program (49.5% White, 36.0% Black, 14.5% Hispanic). During telephone interviews questionnaires were administered to determine feeding style and assess stress, depression and anxiety symptoms. Feeding styles were identified as nonresponsive, responsive, or controlling. Responsive feeding style is identified as one in which the mother provides dietary guidance, recognizes the infants hunger and satiety cues, and responds in ways appropriate for the infant's age. Controlling eating styles are associated with pressuring the infant to eat more food and/or restricting certain types of foods and amounts of foods.

Researchers determined that there was a significant positive relationship between mothers' stress symptoms and forceful or uninvolved feeding practices, as well as between mothers' depressive symptoms and forceful, indulgent and uninvolved feeding styles. Maternal anxiety symptoms were significantly related to restrictive and uninvolved feeding styles. Mothers' perception of child's temperament as fussy was positively associated with restrictive feeding practices and stress, anxiety and depression.

This study was noted because of its examination of an indirect relationship between mental health and nutrition – that of a mother's mental health with her child's nutritional health. Non-responsive feeding styles have been associated with unhealthy weight status in young children, thus a mother's mental health can have a great impact on her child's physical health.

# DPG LESSONS LEARNED AT FNCE 2009

By Cathy Fagen, MA, RD



**Women's Health DPG** joined forces with Sunsweet Growers and two other DPGs (Medical Nutrition DPG and Nutrition Education for the Public DPG) to provide a membership breakfast session at the annual ADA Food & Nutrition Conference & Expo (FNCE) in Denver this past October.

The collaborative efforts resulted in a room packed with members from each of the three DPGs. Sunsweet Growers provided prunes in bulk on the breakfast bar and canisters of Sunsweet Ones (individually wrapped dried plums) and bottles of PlumSmart at our seats. They also sponsored a renowned speaker, Carolyn O'Neill, MS, RD, who conducted a wonderfully entertaining presentation on maintaining optimal digestive health. The presentation and the sample products were very well received. I especially

enjoyed the snack sized packets of PlumSweets – scrumptious, bite-sized pieces of dried plums, coated in rich, dark chocolate. YUM! I thought this snack would be a great Halloween treat since it combines two of nature's best sources of antioxidants, dried plums and dark chocolate. I distributed them to my co-workers and neighbors and they loved them!

Your DPG officers greeted current members and potential members at the DPG Showcase on the second day of the convention. Women's Health DPG ribbons were distributed to our members to wear on their FNCE meeting badge and proudly announce their WH DPG membership to all other RDs. Students and other RDs were able to ask questions about the DPG and the areas of practice in which our members specialize.

I always obtain so much information by attending the annual FNCE meeting. My own professional needs were met this year by the educational sessions I attended and the networking with fellow RDs in our DPG as well as other DPGs. Two great resources I purchased from this networking were Cultural Food Practices, a new ADA book from the Diabetes Care and Education (DCE) DPG and The Indian Vegan Kitchen by Madhu Gadia, MS, RD.

So, the lessons learned were:

- Lesson #1:** Collaborate with other DPGs for Membership Breakfast Meetings.
- Lesson #2:** Continue to work with sponsors for WH DPG activities.
- Lesson #3:** Be sure and attend FNCE 2010 to learn, purchase resources and network more with fellow dietitians and dietetic technicians.



**Thank you to  
Sunsweet Growers, Inc**

Thank you to Sunsweet Growers, Inc for  
their support of the WH, MNPG, NEP DPGs  
breakfast at FNCE in Denver.

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## WH ANNUAL REPORT *June 1, 2008 - May 31, 2009*

**Women's Health (WH) DPG** has been working to encourage the active engagement of as many members as possible through the enhanced web site at [www.womenshealthdpg.org](http://www.womenshealthdpg.org), its listserv and the recruitment of members to participate on various committees, task forces and special projects. As always, we continue to provide members with personal and professional development opportunities to excel and grow through networking, leadership development and specialization.

### Membership

- Membership as of May 31, 2009 was 837.

### Administration

- The Agency on Health Related Quality (AHRQ) evidence topic addressing maternal weight gain and maternal/child health outcomes submitted by ADA in partnership with WH DPG was published in 2008. The evidence report/technology assessment, no. 168 "Outcomes of Maternal Weight Gain" can be found at <http://www.ahrq.gov/downloads/pub/evidence/pdf/admaternal/admaternal.pdf>.
- A research and public policy session on this report was presented at FNCE 2008 in Chicago, IL by Anna Maria Siega-Riz, PhD, RD and WH DPG Past Chair Jeanne Blankenship, MS RD. The CPE level II session entitled "Maternal Weight Gain: The Scientific Evidence"

was held from 12-1:30 pm on Tuesday, Oct 28, 2008. The presentations and handouts for that session can be found at: [http://www.eatright.org/cps/rde/xchg/ada/hs.xsl/education\\_19602\\_ENU\\_HTML.htm](http://www.eatright.org/cps/rde/xchg/ada/hs.xsl/education_19602_ENU_HTML.htm).

- WH DPG was represented by elected and/or appointed officers at the following meetings:
  - ADA Food & Nutrition Conference & Expo (FNCE), Chicago, IL, October 2008.
  - Annual ADA Leadership Institute, Dallas, Texas, June 2008.
  - ADA Public Policy Workshop, February 2009, Web-based meeting.
  - ADA opening NASDAQ Stock Market, March 2009.
- Member Kathleen Pellechia, RD, represented the WH DPG on the committee to update the ADA's Position Paper on Promoting & Supporting Breastfeeding to be published Nov, 2009. Member Lisa Hamlett, MS, RD, IBCLC, served as a reviewer and member Egondu Onuoha, MS, RD, IBCLC, served as a content advisor on this paper.
- WH collaborated with the Public Health and Community Nutrition DPG to staff the Mother's Room at FNCE in Chicago, IL.

Continued on page 12

### *FNCE 2009 - The MOTHERS' ROOM*



"We supported 34 breastfeeding women!"

"Thank You!"



The Mothers' Room is a collaborative effort of ADA and the Public Health/Community Nutrition Practice Group working with the Women's Health Practice Group, the Pediatric Nutrition Practice Group, and General Mills, Inc.



PHCNPG  
Monday, November 02, 2009

## ANNOUNCING THE UNINTENDED WEIGHT LOSS IN OLDER ADULTS (UWL) EVIDENCE-BASED NUTRITION PRACTICE GUIDELINE...FREE TO ALL ADA MEMBERS!

The UWL guideline debuts the EAL's first Nutrition Diagnosis recommendation - Nutrition Diagnosis of Involuntary Weight Loss. You will find additional nutrition recommendations within this guideline related to unintended weight loss in older adults which include the following topics:

- **Medical Nutrition Therapy**
- **Instruments for Nutrition Screening**
- **Assessment of Food, Fluid and Nutrient Intake**
- **Collaboration for Modified Texture Diets**
- **Eating Assistance**
- **Monitor and Evaluate Nutritional Status**

This guideline contains systematically developed recommendations, based on scientific evidence, and is designed to assist practitioners on the appropriate nutrition care for older adults with unintended weight loss.

Members of the expert workgroup – led by Mary Ellen Posthauer, RD, CD, LD, Chair; Ronni Chernoff, PhD, RD; Krista Clark, RD, LD, CNSD; Becky Dorner, RD, LD; Charlette Gallagher-Allred, PhD, RD; and Gretchen Robinson, MS, RD, LD, FADA - with Erica Gradwell, MS, RD, lead evidence analyst, along with trained analysts extensively examined the research to develop a series of recommendations and treatment algorithms which accurately summarize this body of evidence.

To visit the guidelines, go first to [www.eatright.org](http://www.eatright.org), sign-in as an ADA member and then select the Evidence Analysis Library link in the left menu bar of the Home Page. Once you are signed-in to the ADA Evidence Analysis Library®, select the "Guidelines" tab or find the "Unintended Weight Loss in Older Adults" link in the A-Z index.

## WH ANNUAL REPORT Continued from page 11

### Leadership

Officers for 2008-09 year:

- Chair: Jamillah Hoy-Rosas, MPH, RD, CDE
- Chair-elect: Denise Andersen, MS, RD, LD
- Treasurer: Nancy Turnier-Lamoureux, MS, RD
- Secretary: Diane Whelan, MPH, RD
- Past Chair: Cathy Fagen, MA, RD
- Nominating Committee Chair: Gina Jarman-Hill, PhD, RD

### Financial Outcomes

- Expenses totaled: \$12,329.00
- Revenues totaled: \$17,751.00

### Member Services

- WH provided one student FNCE stipend in the amount of \$100.00.
- WH DPG Electronic Mailing List (EML) continued to be a great member service with over 200 members participating.
- WH DPG has increased traffic to its Web site: [www.womenshealthdpg.org](http://www.womenshealthdpg.org) by members seeking past issues of newsletters, teleconference slides, and other resources.
- WH DPG began using Vertical Direct to send periodic e-blasts to members.

### Continuing Education and Professional Development

- WH DPG sponsored the FNCE session "'Hormonal Help: Functional Foods for Women of Reproductive Age" presented on Tuesday Oct 28, 2008 from 9:45 AM - 11:15 AM in Chicago, IL. Featured speakers were Siddika Kasim-Karaka, MD and Gita Patel, MS, RD.
- WH DPG began a series of teleconferences hosted by members on topics in women's health:
  - April Rudat, MsED, RD, LDN presented on Breastfeeding Multiples in October, 2008.
  - Ann Marie Barilla, RD, LDN presented on the Nutrition Care Process in Pregnancy & Lactation in December, 2008.
  - Gita Patel, MS, RD, CDE, LD, presented on Functional Foods in Feb, 2009.

- Judy Simon, MS, RD, CDE, CHES presented on Nutrition & Fertility in May, 2009.

### Publications

The WH DPG has produced many outstanding publications and continued to work on future publications. Featured newsletter topics included:

#### • Summer 2008

Recognition and Treatment Approaches for Polycystic Ovary Syndrome  
Ten Important Things to Know About Polycystic Ovary Syndrome

#### • Fall 2008

Dietary Supplements: Research, Regulations and Resources  
Botanical Dietary Supplements: Focus on Women's Health  
The Choline Gap: A Public Health Issue Among Special Populations

#### • Winter 2009

Functional Foods for Hormonal Health  
The Role of the Registered Dietitian (RD) in Fertility Treatment  
Soyfoods: Functional Foods for Women's Health: A Focus on Breast Cancer and Fertility

#### • Spring 2009

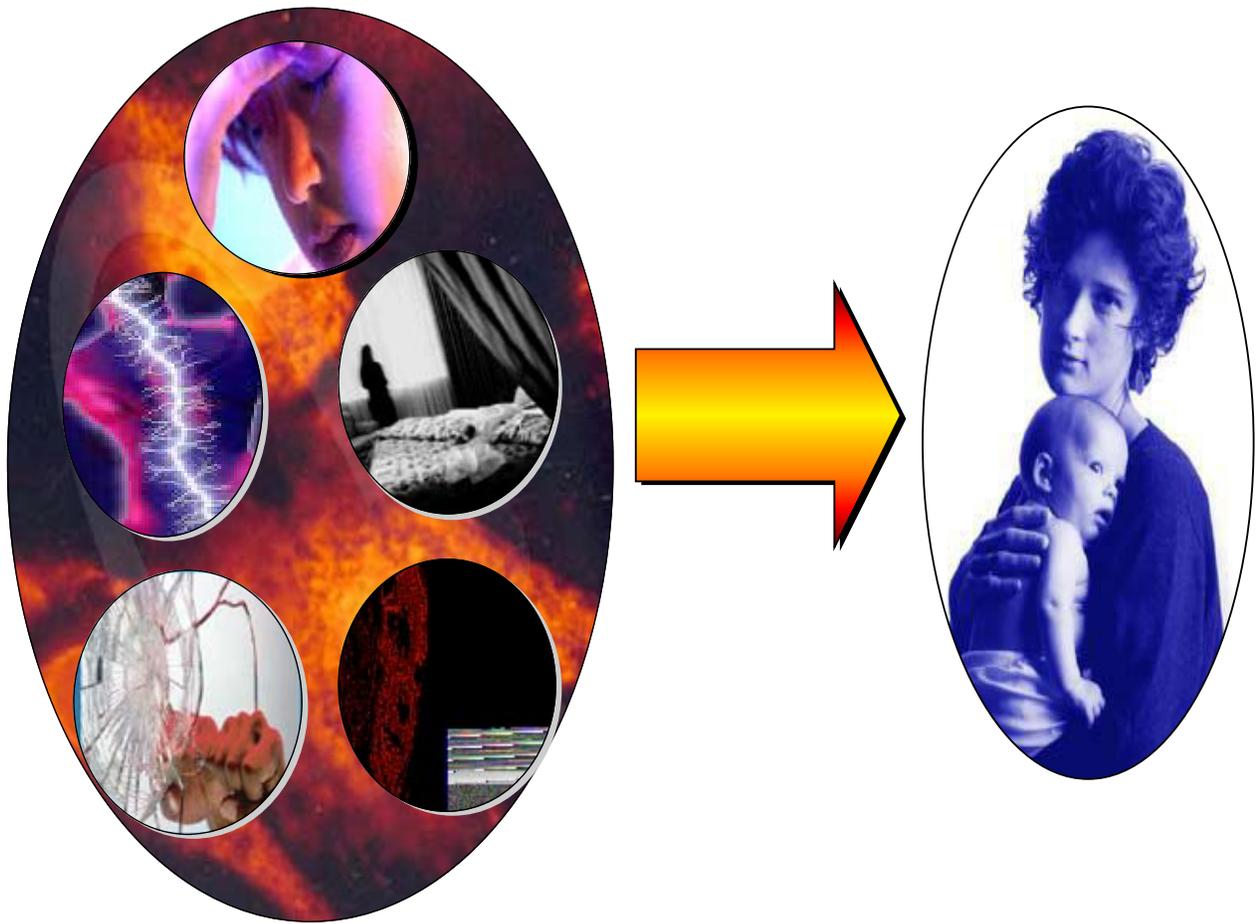
Iodine and Reproductive Nutrition  
Business Case for Breastfeeding

### Alliances/Networks

- Continued WH DPG networks with 3 professional organizations: International Lactation Consultant Association (ILCA), represented by member Ginger Carney, RD IBCLC (This network is also supported by the Pediatric Nutrition DPG), La Leche League (LLL), represented by member Judith Roepke, PhD, RD and International Board of Lactation Consultant Examiners (IBLCE), represented by member Claire Dalidowitz, MS, MA, RD, IBCLC.

### Corporate Sponsorship

- United Soybean Board sponsored the Membership Breakfast Reception at FNCE 2008, Chicago, IL



**Figure 2**

**Risk Factors for Depression in New Mothers – New Paradigm.** Depicts five risk factors for depression in new mothers (stress, sleep disturbance, pain, psychological trauma and a history of abuse or trauma) with inflammation as the underlying risk factor.

elevated [13,14]. In depressed people, inflammation is increased, including high levels of proinflammatory cytokines and acute-phase proteins, such as C-reactive protein (CRP), which are a physiologic response to chronic distress [6,12,13]. Levels of inflammation can be 40% to 50% higher in depressed people than their non-depressed counterparts [15].

The proinflammatory cytokines that researchers identified most consistently as being elevated in depression are interleukin-1 $\beta$  (IL-1 $\beta$ ), interleukin-6 (IL-6), tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), and more recently, interferon- $\gamma$  (IFN- $\gamma$ ) [15]. In the last trimester of pregnancy, levels of proinflammatory cytokines rise [2]. When these cytokines are

within normal levels, they are adaptive because they help prevent infection. When they are abnormally high, they increase the risk of depression. Proinflammatory cytokines cause a constellation of sickness behaviors in humans, which includes alterations in sleep, appetite, activity, mood, energy, sexual activity and socialization – all behaviors associated with depression [2]. The relationship between inflammation and depression appears to be bidirectional: inflammation increases the risk of depression and depression increases inflammation.

Depression can also influence the systems that normally keep inflammation in check, such as the HPA axis. Cortisol is anti-inflammatory and is generally secreted when

inflammation levels get too high. However, depressed people either have abnormally low levels of cortisol or they become less sensitive to cortisol. In either case, cortisol fails to restrain the inflammatory response. In one recent study of 72 women, depressed women had higher levels of IL-6 and TNF- $\alpha$  in response to an acute stressor than women who weren't depressed [15]. Also they were less sensitive to glucocorticoids that normally terminate the inflammatory response system [15]. The authors concluded that the depressed women had a blunted cortisol response to stress [15]. Groër and Morgan in their study of 200 postpartum women also noted a down-regulation of the HPA axis and abnormally low levels of cortisol in depressed women at 4 to 6 weeks postpartum [10].

### *(2) Depression, inflammation and preterm birth*

Depression poses another health risk to puerperal women – increased risk of preterm birth. Several researchers have noted that depression and posttraumatic stress disorder increase risk of preterm birth, and inflammation may explain why [16,17]. In a study of 200 women at 4 to 6 weeks postpartum, depressed mothers had significantly smaller babies, more life stress, and more negative life events [10]. These women also had abnormally low cortisol levels meaning that the inflammatory response was not restrained. Another study in Goa, India (n = 270) found that babies of mothers who were depressed during their third trimester of pregnancy were significantly more likely to have low birth weight babies than their non-depressed counterparts. Mothers who were most severely depressed were at highest risk (Odds Ratio, OR: 2.5); these findings were significant even after for controlling for maternal age, maternal and paternal education, and paternal income [18].

In a prospective cohort study of 681 women, the rate of spontaneous preterm birth for depressed women was more than twice that of women who were not depressed (9.7% vs. 4%; OR: 3.3) [16]. The authors speculated on two possible pathways by which depression might lead to preterm birth. Depression can lead to elevated cortisol levels, which increases corticotrophin releasing hormone (CRH). CRH triggers parturition. The other possible mechanism they cited is activation of the proinflammatory cytokines and prostaglandin E<sub>2</sub>, which is secreted in response to cortisol and proinflammatory cytokines. Prostaglandin E<sub>2</sub> plays a major role in uterine contractions [16].

The proinflammatory cytokines IL-6, IL-8, and TNF- $\alpha$  ripen the cervix before birth and these are also elevated when women are under stress. In a study of 30 pregnant women, Coussons-Read and colleagues found that TNF- $\alpha$  and IL-6 levels were significantly higher, and the anti-inflammatory cytokine IL-10 was significantly lower, in

mothers who were stressed compared with mothers who weren't [4]. The authors hypothesized that inflammation was the likely mechanism to explain the relationship between maternal stress and preterm birth. They noted that high levels of inflammation (particularly IL-6 and TNF- $\alpha$ ) were associated with preeclampsia and premature labor. Infection also increases the risk of preterm birth and TNF- $\alpha$  is released in response to both viral and bacterial infections. They concluded that high levels of proinflammatory cytokines may in fact endanger human pregnancies [4].

Inflammation may also explain another set of findings regarding preterm birth. In a study of 291 low-income pregnant women, participants were randomly assigned to receive either DHA-enriched eggs or regular eggs that they were to consume daily during the last trimester of their pregnancy [19]. This sample was predominantly African American (73%), a group generally at risk for preterm birth. DHA is a long-chain omega-3 fatty acid with anti-inflammatory effects (these effects are described in more detail in a subsequent section). Women who received the DHA-enriched eggs had an average increase in gestation of six days (SD = 2.3) [19]. The DHA-enriched eggs may have increased gestation length by decreasing inflammation.

### *(3) Physical and psychological stressors*

As described in the previous section, human bodies are designed to respond a certain way when they are threatened. These threats can be physical or psychological; the physiological response is the same. Moreover, some types of stressors have both physical and psychological elements. Three stressors – sleep disturbance, pain, and trauma – are particularly relevant to new mothers. Studies that examine these stressors with regard to inflammation are described below.

#### *(a) Sleep disturbances and fatigue*

Sleep disturbances and fatigue are physical and psychological stressors that increase the risk of depression. Fatigue and sleep problems are often overlooked or minimized because they are so common in new mothers. But fatigue is often of great concern to mothers, and quantity and quality of sleep can alter stress both immune function and emotional well-being [9]. McEwen noted that short periods of disrupted sleep can wreck havoc on the physical health of even non-depressed people [20]. Disrupted sleep elevates evening cortisol levels (suggesting dysregulation of the HPA axis), increases glucose and insulin levels, and increases insulin resistance. And disturbed sleep is nearly universal in the postpartum period. In addition, mothers of premature babies or babies with high-needs temperaments may wake frequently at night well beyond the postpartum period. Psychological trauma and current stress can also compromise sleep quality [21,22]. All of

these factors increase the risk of depression both directly and indirectly through sleep disturbance.

Sleep disturbance and depression are also mutually maintaining conditions: sleep disturbance can cause depression and depression causes sleep disturbances. Ross et al. noted that several factors suggest a relationship between sleep problems and depression in postpartum women [23]. These are as follows.

- 1) Insomnia is a significant risk for new-onset depression;
- 2) Sleep disturbances are common in most psychiatric disorders;
- 3) Treatments that manipulate sleep and circadian rhythms can be used to treat mood disorders.

In a review of polysomnographic studies of postpartum women, Ross et al. noted that there are differences in REM latency for women at risk for postpartum depression or who have current postpartum depression – reduced REM latency, increased total sleep time during pregnancy and decreased total sleep time postpartum [23]. REM latency refers to the time during the night when REM sleep becomes the predominant pattern. A pattern of reduced REM latency means that REM occurs earlier in the nightly sleep cycle, and is a symptom of depression. As a result of these sleep disturbances, women are more fatigued during the day. The authors noted that these changes may represent an underlying vulnerability to depression as they do with non-postpartum populations. They also noted that women with a history of affective disorders may be more sensitive to the normal physiologic changes of pregnancy.

Sleep disturbances and fatigue too are related to cytokine levels. When proinflammatory cytokine levels are high, fatigue increases. Moreover, the body experiences disturbed sleep as a physiological stressor [24]. In a sleep study of 22 patients with major depressive disorder (MDD) and 18 age-matched controls, inflammation was associated with sleep disturbances [25]. Prolonged sleep latency and REM density (two markers of disturbed sleep) were better predictors of IL-6 and ICAM (intercellular adhesion molecules – another inflammatory marker) than depressive symptoms. The authors concluded that sleep disturbances were at least the partial cause of elevated inflammation in depressed people [25].

Another study examined the role of the proinflammatory cytokine IL-1 $\beta$  in postpartum women [26]. The researchers found that higher levels of IL-1 $\beta$  were related to fatigue in women at four weeks postpartum. The authors speculated that IL-1 $\beta$  may have an indirect link to postpartum depression through fatigue [26]. Sleep deprivation is also

a stressor that both activates the hypothalamic-pituitary-adrenal (HPA) axis and increases cytokine release in response [27].

In a study of women four to six weeks postpartum, Groër and colleagues found that mothers' fatigue levels correlated with their levels of stress and depression [27]. They also found that fatigue, stress and depression increased the risk of infection for both mother and baby. Fatigue, stress and depression make the immune system less effective, which increases the risk of infection. Interestingly, the same study also found that mothers who were stressed, depressed and fatigued had lower levels of prolactin in both their serum and milk. These same mothers also had higher levels of melatonin in their milk, the hormone that regulates circadian rhythms [27].

In a more recent study of 200 women at 4 to 6 weeks postpartum, Groër and Morgan found that depressed mothers reported more fatigue and daytime sleepiness than non-depressed mothers [10]. The depressed mothers had abnormally low levels of cortisol, which may also cause their fatigue. The authors describe how chronic fatigue syndrome, various chronic pain syndromes, and posttraumatic stress disorder are also associated with low cortisol levels. The depressed mothers also had more health problems since the baby was born and had more health-related events such as sprains, dental pain, and allergies. They had higher levels of perceived stress, anxiety and more negative life events. The serum IL-6 levels were three times higher in the depressed mothers, but this was not a significant difference because of measurement variability [10].

In summary, sleep disturbances and fatigue are physical stressors that increase the risk of depression. The relationship between sleep problems and proinflammatory cytokines appears to be bidirectional: sleep disturbances increase cytokines and cytokines increase sleep disturbance by delaying sleep onset, increasing daytime fatigue, and perpetuating the cycle of disturbed sleep and inflammation. Motivala and colleagues hypothesized that interventions that target disordered sleep may also lower inflammation, thereby lowering the risk of depression [25].

### *(b) Pain*

Pain is another physical and psychological stressor related to increased inflammation and the risk of depression. Pain and depression are highly co-morbid conditions and may have a common etiology [28]. There are many types of pain that postpartum women are likely to experience. Pain can be the result of birth difficulties or breastfeeding difficulties. Pain can be caused by prior psychological trauma, which lowers the pain threshold so that normal sensations are perceived as painful [28]. Pain can also be

caused by autoimmune disease that may appear for the first time in the postpartum period [1].

The relationship between pain and inflammation also appears to be bidirectional. When a woman experiences pain, stress hormones and levels of proinflammatory cytokines increase. High levels of proinflammatory cytokines, in turn, increase pain. Cytokines (especially IL-1) are stimulated by Substance P. Substance P is the neuropeptide that is high in patients with pain. In one study, patients with major depression or posttraumatic stress disorder were compared to healthy controls (n = 101) [30]. The patients with depression or PTSD had significantly elevated levels of Substance P in their cerebrospinal fluid. Moreover, the levels of Substance P rose significantly when the patients were presented with a laboratory-induced stressor that reminded them of their traumatic event. The authors concluded that Substance P was related to both depression and PTSD and responded to acute stress [30]. High levels of Substance P are also related to lower levels of serotonin, which increases the risk of depression. In addition, cytokines increase prostaglandin synthesis, including the prostaglandin cyclooxygenase-2 (COX-2), which increases pain [24,31-33]. In a study of mothers at eight weeks postpartum, a history of either violence or depression increased the risk of postpartum health problems including several types of postpartum pain [29].

Sleep disturbances can also increase pain. An example of the relationship between disrupted sleep and pain is in the chronic pain syndrome fibromyalgia. While this is a controversial diagnosis in some circles, researchers have noted that patients with fibromyalgia have a number of physiologic abnormalities that cannot be influenced by patient report. These include increases in Substance P (up to three times as much compared to healthy controls), decreases in serotonin and the serotonin metabolite 5-HIAA in the cerebral spinal fluid, abnormal brain activation patterns, and of relevance to the present discussion, abnormal sleep patterns [28]. A pattern frequently found in patients with fibromyalgia is interrupted delta (slow-wave) sleep. Interrupted delta sleep means that patients' bodies do not make repairs to muscular micro-traumas that have occurred during the day. The net result is all-over body pain [34]. Fibromyalgia has even been induced in the laboratory, where patients' sleep was monitored, and every time they went into delta sleep they were woken up. By the next morning, they had head-to-toe pain, which resolved once they had a normal night's sleep [34].

An interesting exception to the pain-sleep disturbance phenomenon is co-sleeping. Polysomnographic studies of breastfeeding mothers who are sleeping next to their babies for all or part of the night indicate that the mothers

spend less time in deep sleep than mothers who are not co-sleeping. Despite significantly decreased slow-wave sleep, co-sleeping mothers do not appear to report an increase in body pain [35]. Co-sleeping may be less stressful for mothers than needing to completely wake for night time feeding. Or the higher levels of prolactin that co-sleeping mothers have may have an impact decrease inflammation and pain. This issue has never been specifically addressed and would be an interesting topic for future research.

Pain can be a potent trigger for depression in postpartum women. A common type of pain in the first few weeks after birth is nipple pain. A study of 113 breastfeeding women (48 with nipple pain, 65 without) demonstrated that women with pain were significantly more likely to be depressed than women without pain (38% vs. 14%) [36]. Women in the pain group also had significantly higher scores on the Profile of Mood States questionnaire. Once the pain resolved, the scores on these scales dropped to normal levels [36].

Unfortunately, nipple pain appears to be common, even among educated, middle-class women – the group most likely to breastfeed. In one study in Minneapolis, Minnesota, an astonishing 50% of women had nipple pain at five weeks [37]. Another study from Toronto, Canada had similar results; 52% of mothers reported cracked or sore nipples at two months postpartum [29].

In summary, postpartum pain is a common experience among women who have recently given birth [29]. Addressing pain promptly, and providing mothers the means to cope with their pain can halt the cascade of stress hormones and proinflammatory cytokines, decreasing their risk of depression.

### *(c) Current trauma or history of trauma*

Psychological trauma can also have an impact on depression and cytokine levels. Like depression, posttraumatic stress disorder (PTSD) is a dysregulation of a normal stress response. Cortisol levels can be abnormally high or low. Previous studies found that people with PTSD had abnormally low cortisol levels. When cortisol is not there to inhibit the inflammatory response system, people who have PTSD have increased cytokine activity [38-40]. Even if cortisol is elevated, the receptors can be less sensitive to cortisol and fail to restrain the inflammatory response [41,42].

According to the *Diagnostic and Statistical Manual* [43], a traumatic event is one in which the person felt that death or serious injury was possible for themselves or a loved one, and the person responded with fear, helplessness or horror. In addition, there must be symptoms in each of

these three clusters: 1) intrusion: frequent re-experiencing of the event via nightmares or intrusive thoughts, 2) avoidance: numbing or lack of responsiveness to or avoidance of current events that remind patients of their trauma, and 3) hyperarousal: persistent symptoms of increased arousal including jumpiness, sleep disturbances or poor concentration [43].

PTSD can be caused by a pre-existing trauma, such as sexual assault or natural disaster. Or it can be caused by the birth itself. In a review of the literature, Beck found that the rates of women who met full criteria for PTSD following birth ranged from 1.5% to 6% [44]. The study with 1.5% excluded women with prior depression or PTSD – the very women who are most vulnerable. Even the highest percentage (6%) may seem relatively small. By way of comparison, in the weeks following the September 11th terrorist attacks in 2001, 7.5% of residents of lower Manhattan living near Ground Zero met full criteria for PTSD [45]. It's shocking to realize that the percentage of women meeting full criteria for PTSD after birth is not substantially different than the rates following a terrorist attack. Moreover, even if women do not meet full criteria, they often have symptoms and these can be troublesome, interfere with their sleep and increase the risk of depression [1,46].

### *1) The impact of highly stressful births on breastfeeding*

Women may also have experiences that are highly stressful, while not leading to PTSD [28], can cause breastfeeding difficulties. Women who experience highly stressful births are likely to have abnormally high cortisol levels in the first few days postpartum. And elevated cortisol levels may cause problems. In a study from Guatemala, researchers measured the cortisol levels of 136 women before or after birth. For women with the highest levels of cortisol, lactogenesis II (the onset of copious milk supply) was delayed for several days [47].

### *2) Prior history of depression or trauma*

A woman with a history of depression or trauma is often more vulnerable to current life stresses. One way that that vulnerability manifests is a more rapid inflammatory response to current stressors. This effect has been noted in both human and animal research. For example, in an animal study, prior exposure to a stressor (in this case, inescapable foot shock) led to a hypersensitivity of the inflammatory response system and more rapid release of proinflammatory cytokines when exposed to a subsequent stressor [48]. This is consistent with human studies of childhood abuse that indicate that men and women who are abused in childhood have a significantly increased vulnerability when exposed to current life stressors. They may respond to these current situations with either depression or PTSD [39].

Kiecolt-Glaser and colleagues also noted that stress and depression appear to prime the inflammatory response so that it is more reactive to subsequent stressors [5]. During the postpartum period, women experience a number of significant stressors, such as sleep deprivation and postpartum pain, that increase inflammation and the subsequent risk of depression [2,5]. Women with prior histories of severe stress, depression and trauma are at increased risk of postpartum depression in part because of the way their bodies are primed to react to stress.

### **Implications: goals of prevention and treatment**

A PNI approach suggests two important and related goals for the prevention and treatment of depression in new mothers: reduce maternal stress and reduce maternal inflammation. These recommendations are described below.

#### *(1) Reduce maternal stress*

Since physical and psychological stressors trigger the inflammatory response system, the first goal for preventing or treating depression is to reduce maternal stress. And one important way to do this is for health care providers to encourage mothers to breastfeed, and to support ongoing breastfeeding relationships.

#### *(a) The adaptiveness of breastfeeding*

When breastfeeding is going well, it protects mothers from stress [8,9], thereby protecting maternal mood. A study of 28 mothers who were both breast- and bottle-feeding measured mothers' stress levels immediately before and after both types of feeding. This study was a major methodological improvement over previous studies in that women served as their own controls. Since there were not pre-existing differences between the groups, it was possible to attribute the observed difference in mood to feeding method alone. The researchers found that breastfeeding decreased negative mood and bottle feeding decreased in positive mood in the same women [49].

Another study compared stress levels of three groups of women: women who were exclusively breastfeeding (n = 84), women who were exclusively feeding infant formula (n = 99), and non-postpartum healthy volunteers (n = 33) [50]. The researcher found that breastfeeding women had lower perceived stress, depression and anger, and more positive life events than the controls. Serum prolactin was inversely related to stress and mood in formula-feeding mothers, but this was not true for the breastfeeding mothers. The author concluded that breastfeeding appears to be mildly protective of maternal mood [50]. More recently, these same researchers found in a study of 200 women at 4–6 weeks postpartum, that depressed women were significantly less likely to be breastfeeding and they had sig-

nificantly lower serum prolactin levels. They also reported significantly more life stress and anxiety [10].

A study of 43 breastfeeding women found that both breastfeeding and holding their babies without breastfeeding significantly decreased ACTH, plasma cortisol, and salivary free cortisol [51]. In response to an induced stressor, cortisol responses were attenuated in breastfeeding women for a short time after feeding their babies. The authors concluded that suckling, but not breastfeeding in general, provided a short-term suppression of the stress-related cortisol response and HPA axis response to mental stress [51]. They argued that this short-term suppression provided several evolutionary and biological advantages. It isolated the mother from distracting stimuli, facilitated the women's immune system, protected the babies from high cortisol in the milk and prevented stress-related inhibition of lactation. Based on their review, Groër, Davis and Hemphill drew similar conclusions [9]. They noted that the neuroendocrinology of breastfeeding women possibly down-regulated the stress response. This down-regulation protects the breastfeeding mother and directed her toward milk production, conservation of energy, and nurturing behaviors.

Exclusive breastfeeding also increases the effectiveness of the mothers' immune system [50,51]. In a study of 181 women at 4 – 6 weeks postpartum, perceived stress, depression, anxiety, anger and negative life events were related to decreased immune competence for the formula-feeding mothers [52]. This relationship was not present in the breastfeeding mothers who were protected from the harmful effects of stress on immunity [52].

### *Breastfeeding and stress in babies*

Breastfeeding not only reduces stress for mothers; it also lowers stress that babies experience when their mothers are depressed. Jones et al. compared the infants of four groups of women: depressed mothers who were either breast or bottle feeding, and non-depressed mothers who were either breast or bottle feeding [53]. The outcome was the babies' electroencephalogram (EEG) patterns. This measure is used to determine if infants have physiological symptoms of depression – in this case, a pattern of right frontal asymmetry. Right frontal asymmetry is a pattern that also is found in chronically depressed adults.

The researchers found that the babies of the depressed/non-breastfeeding mothers had the abnormal pattern of right-frontal asymmetry [53]. In contrast, infants of the depressed/breastfeeding mothers had normal EEG patterns. In other words, breastfeeding protected these babies from the effects of maternal depression. The authors explained their findings by noting that the depressed/breastfeeding mothers did not disengage from their

babies the way the depressed/bottle-feeding mothers did. The depressed/breastfeeding mothers continued to look at, touch and stroke their babies because these behaviors are built into the breastfeeding relationship. In contrast, when a mother bottle feeds, she doesn't have to even hold her baby. So it is easier for her to disengage, leading to the symptoms that babies typically exhibit when their mothers are depressed [53].

In summary, breastfeeding protects maternal mood by lowering stress. When stress levels are lower, the mother's inflammatory response system will not be activated, thereby lowering her risk of depression. However positive these results, I must issue one caveat: they only apply when breastfeeding is going well. As noted earlier, when breastfeeding that is not going well, particularly if there is pain, it becomes a trigger to depression rather than something that lessens the risk. Mothers' mental health is yet another reason to intervene quickly when breastfeeding difficulties arise.

### *(b) Exercise and depression*

Another way mothers can reduce stress is to exercise, which has also been found to alleviate depression. In a Finnish population study (n = 3,403), men and women who exercised two to three times a week experienced significantly less depression, anger, cynical distrust, and stress than men and women who exercised less frequently [54].

The efficacy of exercise was also demonstrated in a randomized trial of patients with major depressive disorder. In this study, 156 patients with major depression (>50 years old) were randomized into one of three treatment groups: aerobic exercise alone, sertraline (antidepressant) alone, and a combination of exercise and sertraline [55]. After four months, all three groups showed improvement and there were no significant difference between the groups. In other words, those who were in the exercise-only group experienced as much recovery as those who took either medication alone or in combination with exercise. The more striking findings, however, occurred at 10 months. At that time, the exercise-only group had a significantly lower rate of relapse than either the medication alone or medication/exercise groups. The authors speculated that this was because by learning to exercise, the study had given the exercise-only group a coping tool that they could use when faced with life stressors [55]. This study is particularly noteworthy because it was the first to try exercise as a treatment for major depression.

In summary, by linking stress and depression, the PNI framework provides a rationale for why exercise would be an effective intervention for depression – something practitioners can share with mothers. The goal is improved

mental health, not weight loss (although some might occur). Depressed mothers need this information because exercise is often the very last thing they feel like doing. But exercise is an effective technique for both decreasing their risk of depression and helping them cope with the stresses and strains of early motherhood.

### *(2) Reduce inflammation*

The second recommendation is for mothers to reduce inflammation. As described earlier, psychosocial and physical risk factors for depression increase inflammation, which increases depression risk. One way to decrease inflammation is through consumption of long-chain omega-3 fatty acids. Omega-3s show promise in the treatment of mood disorders according to a 2006 expert panel convened by the American Psychiatric Association [56]. And they do so, in part, by decreasing inflammation. These studies and their relevance to pregnant and postpartum women are described below.

#### *(a) Long-chain omega-3 fatty acids and depression*

Over the past 100 years, the diet of people in many Western cultures has changed substantially. Some have theorized that these changes could explain the increase in depression during this same time period [2,5,57]. Of particular concern is the change in the ratio of omega-6:omega-3 fatty acids, with dramatically decreased omega-3s and increased omega-6s. Omega-6 fatty acids are found in vegetable oils and are a staple of processed foods. Omega-3s are found in fatty fish and some plant sources. While some omega-6s are necessary for good nutrition, they become harmful when the ratio of omega-6s to omega-3s is too high – as it is in modern diets. Kiecolt-Glaser and colleagues noted that the hunter-gatherer diet had an estimated ratio of omega-6s:omega-3s of 2:1 or 3:1 [5]. The typical North American diet ranges from 15:1 to 17:1. In Australia and New Zealand the ratio is 10:1 [57]. With regard to depression, the long-chain omega-3s are of interest: EPA and DHA [58]. ALA is the omega-3 found in flax and other plant sources. ALA is an essential fatty acid, and while important for good nutrition, it has no efficacy in the prevention or treatment of depression [58].

#### *(i) Anti-inflammatory activity of omega-3s*

Omega-3s are powerful anti-inflammatories and lower proinflammatory cytokines. In a large population study, high levels of omega-3s (ALA, EPA and DHA) were related to lower levels of the proinflammatory cytokines IL-1 $\alpha$ , IL-1 $\beta$ , IL-6, and TNF- $\alpha$  and higher levels of anti-inflammatory cytokines such as IL-10. For people with low levels of omega-3s, the opposite was true: these people had high levels of proinflammatory cytokines and low levels of anti-inflammatory cytokines [59]. Higher levels of proinflammatory cytokines increase the risk for depression.

In a study of older adults, the combination of depression and higher omega-6: omega-3 ratios dramatically increased levels of proinflammatory cytokines (IL-6 & TNF- $\alpha$ ) beyond the individual contribution of either variable alone. The authors noted that a diet with a high ratio of omega-6s:omega-3s increases the risk of both depression and diseases related to chronic inflammation including heart disease, diabetes and cancer [5].

EPA and DHA may also increase resilience to stress by regulating and attenuating the stress response. Maes and colleagues noted that an imbalance of omega-6s:omega-3s leads to an overproduction of proinflammatory cytokines in response to psychological stress [11]. When omega-3 levels are higher, the levels of proinflammatory cytokines are reduced. Their study included 27 college students who were exposed to a laboratory-induced stressor. The students with lower serum levels of omega-3s had a significantly greater stress-induced elevation of TNF- $\alpha$  and IFN- $\gamma$  than those with higher serum omega-3s or a lower ratio of omega-6s:omega-3s [11].

#### *(ii) Omega-3s in population studies*

Population studies have provided support for the efficacy of omega-3s in preventing depression and other mental health problems by demonstrating that populations who naturally consume more omega-3s in their diets (usually by eating fatty coldwater fish, e.g. such as salmon or mackerel) have lower rates of a variety of mental health problems. For example, populations with higher levels of EPA and DHA in their diets had lower levels of major depression, bipolar disorder, and future suicide risk [60-62]. A prospective study in Osaka, Japan of 865 pregnant women, however, failed to find a relationship between fish intake or the intake of omega-3 fatty acids and prevention of postpartum depression [63]. These findings could be due to a ceiling effect in that the entire population already eats large amounts of seafood [63].

#### *(iii) Treatment with EPA and DHA*

Positive findings have been noted in randomized clinical trials, where researchers have given either EPA/DHA supplements or a placebo to people currently receiving treatment for unipolar or bipolar depression. When EPA was added to patients' normal regimen of antidepressants, EPA made the antidepressants more effective in treating depression than the placebo [64]. Similarly, in a study of childhood depression, children who received EPA and DHA in addition to their medication had significantly improved depression compared with children who received their medication and a placebo [65]. EPA also helped stabilize symptoms of bipolar disorder in a 12-week double-blind trial [66].

In a recent review, EPA had efficacy in the treatment of depression in four of the six studies reviewed [67]. The authors found that 1 gram of EPA per day was the effective dose. Doses higher than two grams seemed to have the reverse effect [67]. EPA affects the function of both the proinflammatory cytokines and the eicosanoids. The eicosanoids include prostaglandins, leukotrienes and thromboxanes [57]. Given its direct action on proinflammatory cytokines, the efficacy of EPA as a treatment for depression is consistent with previous studies on depression and inflammation.

A preliminary study demonstrated that EPA and DHA may have efficacy in the treatment of postpartum depression. The study was limited, however, by a small sample, no control group, and subjects who were not blind to the treatment condition. This study was intriguing, however, because depression decreased 48% to 51% in the eight-week study period [6]. At the very least, these findings suggest that a follow-up study would be useful.

#### *(iv) DHA in the perinatal period*

During the perinatal period, DHA appears to be particularly important [68]. Pregnant women's diets are often deficient in DHA, which is unfortunate given babies' high need for it in utero. And this may put their mothers at risk for depression. As Rees and colleagues describe, during the last trimester of pregnancy, babies accumulate an average of 67 mg/day of DHA [57]. The average intake for Australian mothers is 15 mg/day. In contrast, DHA consumption among Japanese, Koreans, and Norwegians is about 1000 mg/day. Because babies need DHA for brain and vision development, women's bodies will preferentially divert DHA to the baby, and the baby will take the DHA it needs from maternal stores. With each subsequent pregnancy, mothers are further depleted [36,57]. Current recommended intake is 200 to 400 mg/day as a minimum dose.

DHA appears to have a role in the prevention of depression, but according to two recent reviews, has no efficacy in treatment of depression when used alone [67,69]. In the Adelaide Mothers' and Babies' Iron Trial, a 1% increase in plasma DHA was related to a 59% decrease in depressive symptoms postpartum [57]. In a large population study, women who consumed high amounts of seafood during pregnancy and had high levels of DHA in the milk had lower rates of postpartum depression [70].

DHA may have another effect that could help prevent depression postpartum. In a study of infant sleep, mothers with high levels of DHA during pregnancy had babies who exhibited a more mature sleep pattern in the first few days of life [71]. The investigators examined the ratio of quiet to active sleep using a monitor placed beneath the

crib mattress. A higher percentage of quiet sleep is characteristic of older babies, and is considered a more mature sleep pattern. Babies whose mothers had high levels of DHA during pregnancy exhibited more mature sleep patterns as neonates. The investigators concluded that babies of high-DHA mothers had more mature central nervous systems than babies of mothers who were low in DHA. Although this was not study of depression per se, babies with more mature sleep patterns also allow mothers to get more uninterrupted sleep – and this could have an indirect effect on their mothers' mental health [71].

#### *(v) Sources of EPA and DHA*

As the previously cited studies indicate, women are often deficient in long-chain omega-3 fatty acids during the perinatal period. However, pregnant or breastfeeding women often need to limit the amount of fish they eat, the prime source of EPA and DHA, because of contaminants in seafood. Fortunately, there are alternative sources of EPA and DHA that are tested for contaminants and are contaminant free. A listing of sources of EPA/DHA that are tested for contaminants can be seen in Additional file 1.

#### *(b) Other anti-inflammatory treatments for depression*

In addition to omega-3s, several standard treatments for depression are also anti-inflammatory. For example, the herbal antidepressant St. John's wort has long been known to be anti-inflammatory [72]. Traditional antidepressants are also anti-inflammatory and this may explain their efficacy. For example, a recent study compared C-reactive protein levels in cardiac patients with major depression before and after treatment with selective serotonin reuptake inhibitors (SSRIs). In these patients, C-reactive protein dropped significantly after treatment, independent of whether depression resolved [73].

One could even argue that cognitive therapy is anti-inflammatory. Two recent studies have demonstrated that negative beliefs, such as hostility, can increase the levels of proinflammatory cytokines – especially IL-6 [74,75]. Cognitive therapy is a treatment for depression with known efficacy [76]. The primary goal of cognitive therapy is to reduce negative cognitions. Since negative cognitions increase inflammation, reducing their occurrence will have physical effects as well – primarily reducing inflammation.

### **Conclusion**

Recent research has identified inflammation as a key factor in depression, and inflammatory response system is triggered by both physical and psychological stress. Postpartum women are particularly at risk because their inflammation levels are naturally elevated in the last trimester of pregnancy, and this elevation continues through

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the postpartum period. Two approaches may prevent depression or reduce its severity: lowering maternal stress and reducing inflammation. Breastfeeding has been shown to reduce stress and protect maternal mood. Breastfeeding also reduces stress of babies of depressed mothers and protects them from the harmful effects of maternal depression. Treatment approaches that are anti-inflammatory have efficacy in treating depression. These include EPA and DHA, exercise, cognitive therapy, herbal anti-depressants such as St. John's wort, and standard antidepressants. Research is needed to assess if anti-inflammatory approaches used proactively can prevent depression from occurring in the first place.

### References

Please visit [www.womenshealthdpg.org](http://www.womenshealthdpg.org) for a complete list of references.

### Additional material

#### Additional file 1

Sources of EPA/DHA that are tested for contaminants

Click here for file

[<http://www.biomedcentral.com/content/supplementary/1746-4358-2-6-S1.doc>]

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