Marital Stress: Immunologic, Neuroendocrine, and Autonomic Correlates[a]

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ABSTRACT: Ninety newlywed couples (mean age = 25), selected on the basis of extremely stringent mental and physical health criteria, were admitted to a hospital research unit for 24 hours to provide a detailed assessment of conflict-resolution behaviors and changes in autonomic, endocrine, and immune function. Among these newlyweds, negative or hostile behaviors during marital conflict (coded from videotaped interactions) were associated with increased levels of epinephrine, norepinephrine, growth hormone, and ACTH as well as greater immunological change over the subsequent 24 hours. Wives demonstrated greater and more persistent physiological changes related to marital conflict than husbands. To assess the generalizability of these physiological changes, a similar laboratory paradigm was used with 31 older couples (mean age = 67) who had been married an average of 42 years. Consistent with the data from newlyweds, both endocrinological and immunological data showed significant relationships to negative behavior during marital conflict in these older couples. These findings suggest that abrasive marital interactions have important endocrinological and immunological correlates.

Considerable evidence has accumulated on the relationship between immune function and personal relationships. For example, lonelier medical students had lower natural killer (NK) cell lysis than students who were not as lonely.[1] Medical students who reported greater social support mounted a stronger immune response to hepatitis B vaccine than those with less support.[2] Self-disclosure of traumatic or upsetting events was associated with enhanced lymphocyte proliferation.[3] Spousal caregivers of dementia sufferers who reported lower levels of social support on entry into a longitudinal study and who were most distressed by dementia-related behaviors showed the greatest and most uniformly negative changes in immune function one year later[4]; in subsequent data from the longitudinal study, spousal caregivers who demonstrated poorer augmentation of NK cell lysis to two cytokines reported lower levels of social support and described less closeness in their important relationships than caregivers

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who showed greater NK augmentation.[5] Men and women who had recently undergone a marital separation or divorce had poorer immune function than demographically matched married individuals.[6,7]

Although loss of a spouse through divorce or bereavement has been linked to adverse changes, the simple presence of a spouse is not necessarily protective: A troubled marriage is itself a prime source of stress, while simultaneously limiting the partner's ability to seek support in other relationships.[8] In two small, cross-sectional studies, lower marital satisfaction was associated with poorer immune function, as well as greater depression and loneliness.[6,7] These linkages were provocative, but the cross-sectional designs precluded inferences about the direction of causality; for example, people who were more depressed might have viewed their marriages as less supportive, and/or their depressive symptoms might have potentiated immunological downregulation. Thus, we designed an elaborate longitudinal study to prospectively assess the impact of marital discord.

Ninety newlywed couples, selected on the basis of stringent mental and physical health criteria, were admitted to the Ohio State University (OSU) Clinical Research Center (CRC), a hospital research unit, for 24 hours.[9–12] Early in their 24-hour admission, these newlyweds discussed one or more areas of disagreement for 30 minutes; this "conflict" session was recorded on videotapes that were later scored for problem-solving behaviors using the Marital Interaction Coding System (MICS).[13]

Conflict discussion tasks such as the one employed with newlyweds are widely used in marital research. Across a number of studies, distressed and nondistressed couples show reliable and stable behavioral differences during conflict: Dissatisfied couples behave more negatively toward each other, and they are more likely to reciprocate their partner's negative behaviors[14]; negative communication indices provide much more discriminative and predictive power than positive indices.[15] Nondistressed couples are better able to set limits on negative communication and its reverberations than distressed couples.[15,16]

Among the 90 newlywed couples in our study, the discussion of marital problems led to both immediate and longer term physiological changes related to the degree of negativity or hostility displayed during conflict. For example, we found larger increases in blood pressure that remained elevated longer in high-negative subjects than low negative subjects.[9] These changes appeared to be closely tied to behavior during a 30-min conflict discussion: High- and low-negative subjects did not differ either on baseline cardiovascular measures or in their response to a standard cardiovascular reactivity task conducted later in the day. Moreover, low-negative subjects reported greater reductions in hostility after the conflict task than high-negative subjects.

Consistent with the relationships observed in our blood pressure data, hostile behaviors during conflict also provoked neuroendocrine alterations. The endocrine system serves as one important gateway between personal relationships and health; stress can provoke the release of pituitary and adrenal hormones that have multiple effects, including alterations in cardiovascular and immune function.[17–19] Endocrine samples were collected immediately before, during, and 15 min after the conflict, providing a window on short-term endocrine reactivity: Five of the six hormones that were measured changed during the 30-min problem discussion, and negative or hostile behavior produced greater and/or more persistent alterations in each case.[11] Specifically, hostile behavior during marital conflict was associated with decreased levels of prolactin (PRL) and increased levels of epinephrine (EPI), norepinephrine (NEPI), growth hormone (GH), and adreno-

corticotropic hormone (ACTH). Clearly, negative behavior during marital conflict can provoke short-term or "phasic" endocrine changes.

The majority of psychoendocrine studies have focused on the three classic stress hormones, EPI, NEPI, and cortisol, and most have addressed *acute* responses to discrete novel or stressful events.[20] However, *chronic* stimulation of cortisol and catecholamine secretion at lower levels has been more clearly linked to cardiovascular pathology[20] and immune function.[17,21] The ability to "unwind" after stressful encounters, that is, quicker return to one's neuroendocrine baseline, influences the total burden that stressors place on an individual.[22] Stressors that are resistant to behavioral coping, particularly stressors perceived as unpredictable and uncontrollable, may continue to be associated with elevated stress hormones even after repeated exposure.[21] Accordingly, we also used pooled blood samples acquired hourly from 8:00 A.M. through 10:00 P.M. to provide composite daytime values for the hormones; the pooled samples reflect an integrated value across the day, providing a stronger basis for health-related inferences. These composite data provided a window on endocrine function in couples for whom the day included a conflict.[10] For wives, higher probabilities of husband's withdrawal in response to wife's negative behavior were associated with higher NEPI and cortisol levels. In addition, higher frequencies of positive behaviors were associated with lower EPI and higher PRL levels among wives. Husbands' endocrine data were not associated with behavioral data.

Blood samples for immunological assays were drawn on entry into the hospital and again 24 hours later, just before departure. Subjects with higher frequencies of negative or hostile behaviors during marital conflict showed greater decrements over the 24 hours relative to low-negative subjects on four functional immunological assays (NK cell lysis, the blastogenic response to two mitogens, and the proliferative response to a monoclonal antibody to the T3 receptor), as well as larger increases in the numbers of total T-lymphocytes and helper T-lymphocytes[9]; the elevated plasma EPI levels in high-negative subjects are the likely mediator for the increased numbers of T-lymphocytes and changes in T-cell subsets.[23,24] Negative behavior in these newlyweds was also associated with antibody titers to latent Epstein-Barr virus (EBV), suggesting that differences in cellular immune function and elevated stress hormone levels were modulating the steady-state expression of latent EBV before the 24-hour period of study; the cellular immune response is responsible, in part, for control of latent EBV.[25]

In summary, we found pervasive differences in autonomic, endocrine, and immune function reliably associated with negative or hostile behaviors during marital conflict, and these differences were apparent even among very happy couples in their first year of marriage.[9–12] Positive or supportive problem-solving behaviors were largely unrelated to the physiological indices. Women showed greater physiological change than men. These physiological differences were particularly noteworthy because marital satisfaction was very high on entry into the study, and couples had been selected on the basis of stringent mental and physical health criteria.

LONGITUDINAL ANALYSES: PHYSIOLOGICAL CHANGES AND MARITAL QUALITY

Declines in self-rated marital quality appear to be a stable response to the first year or two of marriage.[26,27] For some couples this decline is dramatic; about a

third of divorces occur within the first four years of marriage.[28] Not surprisingly, the ways that spouses relate to each other influences marital satisfaction. In the early stages of marriage, negative interactions appear to influence subsequent marital satisfaction, rather than the reverse[27,29]; for example, dating couples' evaluations of their partners' communications were not related to initial relationship satisfaction, but did predict subsequent ratings of marital quality, a process Markman[27] labeled a "sleeper effect." Similarly, Kelly[29] found that interpersonal patterns (particularly conflict) were the best predictors of changes in newlywed couples' feelings about their relationship two years later, rather than vice versa, and these associations were stronger for wives than for husbands.

One study suggested that declines in marital quality might have physiological correlates. Among 19 married couples who had been selected on the basis of high or low scores on a measure of marital satisfaction, greater autonomic "linkage" at the initial assessment was associated with larger declines in marital satisfaction three years later.[30]

Using data from our newlyweds, we assessed the contributions of behavior and physiological change to decrements in marital quality. By the second year in the study, the average Marital Adjustment Test (MAT)[31] score had dropped from 128 (SD = 14.75) in year 1 to 120 (SD = 18.49) in year 2 for the 67 couples who provided data at both points in time. Using the year 2 MAT as the dependent variable, we entered the year 1 MAT on the first step of a hierarchical regression. Three behavioral variables from the MICS were entered on the second step: the couple's frequency of negative behaviors, the subject's own frequency of positive behaviors, and the frequency of the wife's avoidant behaviors.[32] On the third and final step the summary immune change index was entered (for details on its computation, see Kiecolt-Glaser *et al.*[9]).

Initial marital satisfaction was a significant predictor of year 2 MAT score for both women, beta = 0.62, $p < 0.001$, $R^2 = 0.36$, and men, beta = 0.44, $p < 0.01$, $R^2 = 0.21$. For the second step, MICS-coded behaviors from the first year of the study did not contribute significantly to variance for either women or men. For men, the immunological change index did not increment the variance on the third step. In contrast, for women, the addition of the immunological change score boosted R^2 for women to .43 (beta = 0.24, $p < 0.05$). Substituting husbands' frequency of avoidant behaviors for those of the wife did not alter results for men or women.

Thus, those women who showed the greatest change in immune function following the conflict discussion also showed the largest declines in marital satisfaction a year later. Immunological responses to conflict may be one bellwether for subsequent changes in feelings about the relationship.

The gender differences found in our longitudinal data are consistent with other evidence that women show greater sensitivity to negative marital interactions than men.[33,34] Wives demonstrate more detailed and vivid memories of marital disagreements than their husbands.[35] Wives also report that they reminisce more frequently about important relationship events and spend more time thinking about their marital relationships than their husbands.[35,36] Because memories of stressful experiences can themselves continue to evoke stress-related physiological changes,[21] women's stronger and more enduring memories may help sustain their physiological arousal. Indeed, increased sympathetic nervous system activity has been reliably associated with intrusive thoughts about past stressors in both clinical and nonclinical samples.[21,37]

Bradbury and Karney[32] suggest that the negative affect engendered by unresolved marital disagreements may carry over into subsequent discussions, leading

to decreased satisfaction with the marriage. In other physiological data from this study, relationships between physiological change and negative behaviors have been significantly stronger for women than for men, and women's physiological changes following marital conflict show greater persistence than men's.[9,11] Other researchers have also found stronger associations between physiology and behavior for women.[38–40] Women's greater sensitivity to negative marital interactions clearly has physiological correlates, consistent with epidemiological evidence that marriage appears to be more beneficial for men's health than women's.[41,42]

IMMUNE AND NEUROENDOCRINE CORRELATES OF MARITAL SATISFACTION IN OLDER ADULTS

Convergent evidence from psychosocial and immunological domains suggests that the links between marital discord and immunity could be stronger and could have more potent health consequences for older adults than younger adults. The number of relationships diminishes as people age, and the quality of close relationships becomes more salient.[43] Consequently, troubled marital relationships could have a greater impact on older adults because of their smaller social networks.[43] In addition, immune function declines with age, particularly functional aspects of the cellular immune response.[44,45] Finally, age and distress may interact to promote immune downregulation: Older adults show greater immunological impairments related to depression than young adults.[46] Accordingly, the increased depression and distress that are reliably associated with chronically abrasive marital relationships[47,48] could have a greater physiological impact in older adults.

To address these issues, we assessed endocrinological and immunological correlates of marital conflict and marital satisfaction in 31 older couples (mean age = 67) who had been married an average of 42 years.[49] Couples were admitted to the CRC for 8 hours, and blood was drawn on entry for immunological assays; for endocrine analyses, five blood samples were drawn during a 30-minute conflict discussion and a 15-minute recovery session. The conflict session was recorded on videotapes that were later coded for problem-solving behaviors using the MICS. Among wives, escalation of negative behavior during conflict and marital satisfaction showed strong relationships to endocrine changes, accounting for 16% to 21% of the variance in the rates of change of cortisol, ACTH, and norepinephrine (but not epinephrine). In contrast, husbands' endocrine data did not show significant relationships with negative behavior or marital quality. Both men and women who showed relatively poorer immunological responses across three functional assays (the blastogenic response to two T-cell mitogens and antibody titers to latent Epstein-Barr virus) displayed more negative behavior during conflict; they also characterized their usual marital disagreements as more negative than individuals who showed better immune responses across assays. Clearly, abrasive marital interactions have physiological consequences even among older adults in long-term marriages.

These data from both newlywed and older couples provide a window on the pathways through which close personal relationships could affect physiological functioning and health; however, these data are likely to underestimate the actual physiological impact of marital discord, since marital satisfaction was well above average in both samples.

Other data from our laboratory have highlighted potential health consequences of chronic stress for older adults. We found large differences in both the

antibody- and virus-specific T-cell responses to influenza vaccination when we compared spousal caregivers for dementia sufferers and well-matched controls.[50] Influenza and pneumonia are major causes of morbidity and mortality among older adults; thus, it is of particular concern that older adults who show poorer responses to influenza vaccine and other antigenic challenges also experience higher rates of clinical illness, including influenza virus infection.[51,52]

Furthermore, stress-related immunological downregulation has additional health implications beyond infectious disease: The immune system plays an important role in the wound-healing process. We have also found that dementia caregivers showed a diminished proinflammatory cytokine response compared to controls, as well as slower wound repair[53]; caregivers took an average of 9 days longer to heal a 3.5-mm punch biopsy wound than controls, that is, 24% longer to repair a small, standardized wound. Consequently, stress-related alterations in immune function could have health repercussions across several domains, particularly among older adults.

Data from large, well-controlled epidemiological studies suggest that poor personal relationships constitute a major risk factor for morbidity and mortality, with statistical effect sizes comparable to those of such well-established health risk factors as smoking, blood pressure, blood lipids, obesity, and physical activity.[42] Marriage is a key personal relationship; data from studies such as those described above can help advance our understanding of the pathways through which close personal relationships influence health.

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