A wealth of clinical and pre-clinical research indicates that psychological stress suppresses various aspects of innate and adaptive immune function, and can ultimately impact upon disease onset and/or progression (Glaser and Kiecolt-Glaser, 2005; Kemeny and Schedlowski, 2007). Specifically, evidence indicates that psychological stress suppresses a range of immune parameters, results in impaired host resistance to infectious disease, results in reduced responses to vaccinations, inhibits wound healing and increases the progression of cancer (Glaser and Kiecolt-Glaser, 2005; Kemeny and Schedlowski, 2007). However, on the contrary, there is evidence indicating that in some instances stress can promote an inflammatory environment that could have a deleterious effect on the progression of autoimmune disease (Kemeny and Schedlowski, 2007). In general, the impact of stress on functioning of the immune system is thought to depend on the severity and duration of the stressful situation (Kemeny and Schedlowski, 2007; Segerstrom and Miller, 2004).

Considering the deleterious effects of stress on health, a key objective of future research in the field of psychoneuroimmunology is to identify interventions that can ameliorate stress-induced immunological dysfunction and increases in disease susceptibility. Whilst the evidence indicates that treatment with anxiolytic medications such as benzodiazepines can ameliorate stress-induced immunological changes (Benschop et al., 1996; Zavala, 1997), non-pharmacological approaches that can ameliorate stress-induced immune dysfunction have obvious advantages over pharmacological ones. With this objective in mind, the paper by Koh and co-workers published in the current issue of Brain, Behavior, and Immunity (Koh et al., 2008) examines the effect of relaxation training on pro-inflammatory (TNF-α and IL-6) and anti-inflammatory (IL-10) cytokine production from peripheral blood mononuclear cells (PBMCs) during a baseline (non-stressful) and pre-examination (stressful) period. The objective of the experiment was to determine if psychological intervention with relaxation training could help students cope with stress, and thereby ameliorate stress-related changes in immunological function. Koh and co-workers randomly assigned 36 medical students to either a relaxation training intervention group or a non-intervention control group. Students were tested 4 weeks prior to examinations (baseline period) and 3 days before final quarterly examinations (pre-examination period). All subjects completed two stress scales (GARS and SRI) and a psychopathology assessment scale (SCL-90-R), provided blood pressure measurements and blood samples for PBMC isolation. The authors report that production of the pro-inflammatory cytokine IL-6 was significantly reduced during the stressful (pre-examination) period, and production of the anti-inflammatory cytokine IL-10 was enhanced during the same period. Upon analysis of the impact of relaxation training on immunological changes (stress period values minus baseline period values) there was a significant attenuation of the stress-related reduction in IL-6 and TNF-α, but a further increase in IL-10 production in students that underwent relaxation training. Whilst these immunological changes were accompanied by reductions in blood pressure and GARS scores, surprisingly, changes in GARS scores and blood pressure were not significantly correlated with changes in production in any of the cytokines. The authors concluded that relaxation is more likely to have counter-stress effects on pro-inflammatory cytokines than on anti-inflammatory cytokines.

For the most part these observations by Koh et al. (2008) are concordant other reports indicating that psychological interventions that inhibit stress-perception, or enhance stress coping mechanisms, ameliorate stress-induced immunological dysfunction. For instance, a recent report indicates that a psychological intervention that facilitated coping (mindfulness based stress management approaches) had increased lymphocyte proliferative responses relative to HIV patients that did not undergo any of these programmes (Witek-Janusek et al., 2008). Similarly, another study reported that HIV patients that underwent a 10-week programme of cognitive-behavioral relaxation training, focused tai chi training, or attended spiritual growth groups (all of which are regarded as stress management approaches) had increased lymphocyte proliferative responses relative to HIV patients that did not undergo any of these programmes (McCain et al., 2008). By contrast, the observation by Koh et al. that stress-induced IL-10 production was increased in the relaxation group was a surprising finding when taken at face value. However, upon closer inspection of the data it is clear that the absolute concentration of IL-10 was not increased in the relaxation group relative to the non-intervention group in response to examination stress. The exaggerated increase in IL-10 production (stress period value minus baseline period value) reported in the group receiving relaxation training simply occurred due to reduced baseline IL-10 production in the relaxation group relative to the non-relaxation group. This is likely to be a random effect due to the relatively small sample size employed in the study. Thus my interpretation of the results is that the relaxation regime attenuated, albeit modestly, the stress-related impairment in pro-inflammatory cytokine

**Brief Commentary**

**Don’t stress out your immune system – Just relax**

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A wealth of clinical and pre-clinical research indicates that psychological stress suppresses various aspects of innate and adaptive immune function, and can ultimately impact upon disease onset and/or progression (Glaser and Kiecolt-Glaser, 2005; Kemeny and Schedlowski, 2007). Specifically, evidence indicates that psychological stress suppresses a range of immune parameters, results in impaired host resistance to infectious disease, results in reduced responses to vaccinations, inhibits wound healing and increases the progression of cancer (Glaser and Kiecolt-Glaser, 2005; Kemeny and Schedlowski, 2007). However, on the contrary, there is evidence indicating that in some instances stress can promote an inflammatory environment that could have a deleterious effect on the progression of autoimmune disease (Kemeny and Schedlowski, 2007). In general, the impact of stress on functioning of the immune system is thought to depend on the severity and duration of the stressful situation (Kemeny and Schedlowski, 2007; Segerstrom and Miller, 2004).

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production, but failed to prevent the stress-related increase in production of the anti-inflammatory cytokine IL-10.

In all, studies in this area make an important contribution to the field of psychoneuroimmunology, because they provide a biological basis to the notion that controlling stress levels can be beneficial to health via actions on the immune system. Despite the contribution of this research to the field, a number of outstanding questions remain. (1) Does relaxation training ameliorate stress-induced immune dysfunction by reducing activation of the HPA axis, SNS, or both? (2) Does the ability of relaxation training to ameliorate stress-induced changes in IL-6 and TNF-α production correlate with any individual items, or cluster of items, on the GARS or SRI scales? (3) Can relaxation training alleviate the immunological effects of chronic stress? (4) What is the impact of relaxation training on stress-induced alterations in more sophisticated measures of immune function? (5) What is the impact of relaxation training on disease susceptibility and progression? Consequently, future studies should focus on assessing the impact of relaxation, and other interventions that can reduce stress-perception, or facilitate coping with stress, on a wide range of immune function tests, circulating cortisol and catecholamine concentrations and on disease susceptibility and progression. This additional research is required to substantiate the argument that relaxation can fend off the deleterious effects of stressful life events on our fragile immune systems.

References