HHS Public Access

Author manuscript

Teach Psychol. Author manuscript; available in PMC 2016 October 17.

Published in final edited form as:

Teach Psychol. 2016 October ; 43(4): 346–355. doi:10.1177/0098628316662768.

Life Stress and Health: A Review of Conceptual Issues and Recent Findings

George M. Slavich[1]

[1]Cousins Center for Psychoneuroimmunology and Department of Psychiatry and Biobehavioral Sciences, University of California, Los Angeles, CA, USA

Abstract

Life stress is a central construct in many models of human health and disease. The present article reviews research on stress and health, with a focus on (a) how life stress has been conceptualized and measured over time, (b) recent evidence linking stress and disease, and (c) mechanisms that might underlie these effects. Emerging from this body of work is evidence that stress is involved in the development, maintenance, or exacerbation of several mental and physical health conditions, including asthma, rheumatoid arthritis, anxiety disorders, depression, cardiovascular disease, chronic pain, human immunodeficiency virus/AIDS, stroke, and certain types of cancer. Stress has also been implicated in accelerated biological aging and premature mortality. These effects have been studied most commonly using self-report checklist measures of life stress exposure, although interview-based approaches provide a more comprehensive assessment of individuals' exposure to stress. Most recently, online systems like the Stress and Adversity Inventory (STRAIN) have been developed for assessing lifetime stress exposure, and such systems may provide important new information to help advance our understanding of how stressors occurring over the life course get embedded in the brain and body to affect lifespan health.

Keywords

stress; measurement; mechanisms; cytokines; inflammation; interventions; STRAIN; health; disease; risk; transformational teaching; classroom instruction

The notion that psychological stress can affect mental and physical health is extremely popular nowadays. Indeed, one can hardly read the news without seeing a new article detailing the deleterious effects that stress has on health or describing how individuals can better cope with stress to reduce their disease risk, enhance their well-being, and realize their "full potential." The television provides little relief in this regard. There, people hear about new psychopharmacological, herbal, and behavioral remedies that promise to reduce their stress levels and risk for a variety of health conditions, some of which are well known (e.g., chronic pain, depression) and others of which were recently invented (e.g., "Low T" [testosterone]).

Corresponding Author: George M. Slavich, Cousins Center for Psychoneuroimmunology, University of California, Los Angeles, UCLA Medical Plaza 300, Room 3156, Los Angeles, CA 90095-7076, USA. gslavich@mednet.ucla.edu.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

This tremendous interest in stress makes sense given the fundamental drive that humans have to better understand life's circumstances and factors that ultimately impact survival. At the same time, viewing stress as an obvious trigger of disease—or as a construct that has a face-valid, commonly agreed upon definition—has led to substantial complication and confusion. Even in the scientific literature on stress and health, the construct of "stress" is frequently described in different ways and often with little detail or specificity. Likewise, although it has long been assumed that stress affects health, exactly how stress gets "under the skin" to promote disease has remained largely unknown. This has occurred in part because scientists have only recently developed the tools that are necessary to assess biological processes that link experiences of stress with disease pathogenesis.

The purpose of this article is to briefly review contemporary ideas and research on stress and health. First, I examine some ways in which stress has been conceptualized and defined over the years. Second, I describe self-report and interview-based instruments that have been developed to assess life stress exposure. Third, I summarize recent findings linking stress and health and mechanisms that might underlie these effects. Fourth, I highlight the emerging focus on examining associations between lifetime stress exposure and health. Finally, I introduce some techniques that instructors can use to teach students about stress and health.

Historical Perspectives on Stress

The belief that daily life can be filled with persistent problems and unrelenting challenges goes back centuries. In Greek mythology, for example, Sisyphus is seen pushing a boulder up a mountain repeatedly, day after day, only to have it roll back down just before he gets to the top (Camus, 1955). The metaphor is physical but conjures up modern images of finishing a long list of tasks, only to be given more by your boss, or cleaning out your e-mail inbox, only to wake up to 15 new messages the next morning. In more recent times, Sir Clifford Allbutt (1895) wrote about how the "whirl of the railway, the pelting of telegrams, the strife of business, the hunger for riches, [and] the lust … for coarse and instant pleasures" (p. 214) caused nervousness, disability, hysteria, and frightfulness. Fast-forward to today and the conversation involves how car traffic, the never-ending flow of digital messages, and the complexities of juggling school, work, and family life are making people anxious, depressed, and physically ill. Although the definition of stress has changed over time, therefore, the notion that stress is an inherent part of life has remained constant (Monroe & Slavich, 2016).

General interest and writing about stress led the way to more formal thinking about this construct during the 19th century. Claude Bernard and Charles Darwin were among the first to describe how, in order to survive, organisms must adapt to ever-changing environmental circumstances (Weiner, 1992). Then, during the 20th century, specific terms for conceptualizing stress emerged. Walter Cannon was among the first theorists to discuss how common emotions have specific physiologic consequences that help the body maintain homeostasis during different situations (Weiner, 1992), and Hans Selye was the first to systematically investigate how different types of social–environmental provocation affect the body (Selye, 1976). Selye's work was extremely influential in this context, and his

perspective still pervades thinking and research on stress and health. According to Selye (1976), stress is “the nonspecific response of the body to any demand” (p. 74), and stressors are “that which produces stress” (p. 78).

Conceptualization and Measurement of Life Stressors

One important consequence of Selye’s work was that scientists could now make clearer distinctions between external life stressors, such as an argument with a friend or boss, and the internal biological effects that such stressors have on the body. This distinction spurred increased interest in measuring the activity of different biological systems (e.g., brain, sympathetic nervous system, immune system) that might respond to stressors in the environment, as well as an increased focus on assessing life stressors (e.g., divorce, getting fired, being physically attacked). An early technique for assessing stressors was Adolph Meyer’s “life chart” methodology, which enabled researchers to categorize the stressors that individuals experienced (Meyer, 1951). In the 1960s and 1970s, though, comprehensiveness gave way to simplicity, and researchers began using easy-to-complete, self-report checklist measures of life stressor exposure, in which respondents simply indicate whether they have experienced each stressor described on a list (Dohrenwend, 1998; Monroe, Slavich, & Georgiades, 2014). Some of the most commonly used self-report checklist measures of stress exposure are the Social Readjustment Rating Scale (Holmes & Rahe, 1967), the List of Threatening Experiences (Brugha & Cragg, 1990), the Childhood Trauma Questionnaire (Bernstein et al., 1994), and the Adverse Childhood Experiences questionnaire (Felitti et al., 1998). The most frequently used measure is probably the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983), although this instrument assesses aspects of the stress experience (e.g., “How often have you felt nervous and stressed?”) as opposed to a person’s exposure to specific stressors.

Although self-report checklist measures are inexpensive and relatively easy to administer, researchers have raised concerns about their reliability and validity (Brown, 1974; Dohrenwend, 2006; Hammen, 2005; Monroe, 2008; Paykel, 2001). The first concern involves whether individuals can accurately remember life events that have happened to them without the assistance of an interviewer who can remind the person of specific events or dates. Research has demonstrated that people can reliably recall major life stressors over long periods of time, but that the quality of such reports is best when individuals’ life histories are probed in a systematic manner by a trained interviewer (Brewin, Andrews, & Gotlib, 1993). Because memories of important events can change over time and can be influenced by mood, a second concern involves whether individuals can self-report on the nature or severity of past stressors in an objective, unbiased manner. This is a particularly important issue in research on stress and depression, given that depressed individuals often exhibit negative biases in attention and memory (Gotlib & Joormann, 2010). Because self-report checklist measures typically describe stressors in relatively general terms, a third concern involves whether researchers actually know what has happened to a respondent given his or her endorsement of a particular item on a checklist. If a checklist item reads, “Did you experience a recent illness or injury?” for example, a person’s endorsement of that item might mean that he or she recently broke a toe, but it could also mean that the person was diagnosed with cancer. Finally, there are concerns about the extent to which self-report

checklist measures of stress inadvertently assess the outcomes under study. For example, some checklist measures enquire about sleep problems, anxiety symptoms, and other affective and behavioral outcomes, and this can conflate the measurement of stress with the dependent variables being examined.

To address these limitations, researchers have developed a number of interview-based systems for assessing life stress exposure. These systems ask different questions, but they are similar in that each employs a trained interviewer who inquires about the respondent's recent life experiences in great detail. To ensure that the stressors are properly characterized with respect to their severity and specific features, the information that is collected about each stressor is then summarized and presented to a panel of expert raters who make consensus judgments about the timing, nature, and severity of each reported stressor. Two of the most commonly used interview-based systems for assessing recent life stress exposure are the Life Events and Difficulties Schedule (Brown & Harris, 1978) and the UCLA Life Stress Interview (Hammen et al., 1987).

Dimensions and Characteristics of Life Stressors

A major benefit of interview-based systems for measuring life stress is that they yield a tremendous amount of information about each stressor, including when and how many times the stressor occurred, how long it lasted, and how it impacted the person's life. This information enables investigators to verify that the stressors being analyzed occurred before (and not after) the health problems they are trying to study, to distinguish between acute and chronic stressors, and to assess the impact that different types of life experiences have on health. Interview-based systems also produce a wealth of information about the social–psychological characteristics of each stressor, and this information can in turn be used to identify the specific forms and features of life stress that are most relevant for different health outcomes.

The accumulation of stressor characteristics data from so many instruments has given rise to numerous ideas regarding what exactly makes stress harmful for health. Despite great interest in identifying the most deleterious aspects of stress, however, there is little agreement on what features of stressors are most important to measure. One early and still very dominant perspective, based on Selye's work, is that life stress represents a singular construct, wherein stressors of different types have similar effects on the body. A second idea propagated by Holmes and Rahe (1967) is that stressors can be ranked by the degree of change or upheaval they typically cause in individuals' lives. A third perspective derived from the work of Steven Maier, Jay Weiss, Martin Seligman, and others focuses on the extent to which people perceive stressors as controllable (Maier, 1986; Seligman, 1975; Weiss & Goodman, 1985; for a review, see Maier & Watkins, 2005). A fourth formulation, adopted mostly by psychopathology researchers, is that stressors can be sorted into life domains, such as "interpersonal" and "achievement," and that a stressor's impact is enhanced when it matches the content of a person's cognitive vulnerability (e.g., a rejection-sensitive person experiencing an interpersonal stressor; Clark & Beck, 1999). Finally, a fifth perspective advanced by Brown and Harris (1978) is that stressors are most impactful when

they cause substantial cognitive upheaval or disrupt a person's goals, plans, and aspirations for the future.

In addition to these formulations, some researchers have taken a more evolutionarily based perspective on what makes particular stressors stressful. Broadly speaking, these theories underscore that humans are fundamentally motivated to maintain close social bonds because of the nurturance and protection that others provide (e.g., Baumeister & Leary, 1995; Gilbert, 1992; Leary, 2007). As a result of this innate motivational drive, the termination of close social bonds is hypothesized to be particularly emotionally distressing, especially when such bonds are intentionally terminated. Several studies have examined predictions derived from these theories, and this body of work suggests that stressors involving interpersonal loss are some of the strongest precipitants of emotional distress, even when compared to other stressors that are similarly severe (Kendler, Hettema, Butera, Gardner, & Prescott, 2003; Slavich, Thornton, Torres, Monroe, & Gotlib, 2009; see also Brown, Harris, & Hepworth, 1995). Moreover, experiences of interpersonal loss may make individuals more sensitive to subsequent stressors involving loss (Slavich, Monroe, & Gotlib, 2011), with individuals' perceptions of such events potentially playing an influential role in shaping the stress experience and response (Blascovich, 2007; Crum, Salovey, & Achor, 2013; Lebois, Hertzog, Slavich, Feldman Barrett, & Barsalou, 2016). In sum, then, although the concept of stress has been viewed from many different angles over the years, one of the most recent and fruitful perspectives has been to understand the implications that stressors have for social relationships, with a particular focus on the different circumstances under which interpersonal loss can occur (e.g., death of a loved one vs. a relationship break up).

Stress and Health

These developments in the conceptualization and measurement of life stress have helped greatly advance the science of stress and health. Indeed, nowadays, there is little debate about whether life stress plays a role in affecting health. As summarized in Figure 1, extensive research has examined these effects, and the take-home message from this literature is that stress exposure increases risk for poor clinical outcomes across a variety of major health conditions, including rheumatoid arthritis (Cutolo & Straub, 2006), depression (Kendler, Karkowski, & Prescott, 1999; Monroe, Slavich, Torres, & Gotlib, 2007), cardiovascular disease (Kivimäki et al., 2006), chronic pain (Loeser & Melzack, 1999), human immunodeficiency virus/AIDS (Leserman, 2008), ovarian cancer (Lutgendorf et al., 2013), and breast cancer (Bower, Crosswell, & Slavich, 2014; Lamkin & Slavich, 2016). Stress has also been implicated in accelerated biological aging and premature mortality (Epel et al., 2004; Holt-Lunstad, Smith, & Layton, 2010; for a review, see Cohen, Janicki-Deverts, & Miller, 2007).

Mechanisms Linking Stress and Health

Given that life stress is associated with so many different health outcomes, researchers have recently attempted to identify whether stress increases risk for different disorders through a common biological pathway. One of the most recent and potentially important findings in this context involves the discovery that stress can upregulate components of the immune

system involved in inflammation (Segerstrom & Miller, 2004; Slavich & Irwin, 2014). Moreover, consistent with the stress–health links described above, there is emerging evidence showing that stressors involving interpersonal loss and social rejection are among the strongest psychosocial activators of molecular processes that underlie inflammation (Murphy, Slavich, Chen, & Miller, 2015; Murphy, Slavich, Rohleder, & Miller, 2013; for a review, see Slavich, O'Donovan, Epel, & Kemeny, 2010). Although inflammation is typically thought of as the body's primary response to physical injury and infection, researchers have recently identified that inflammation plays a role in several of the most burdensome and deadly diseases (Couzin-Frankel, 2010; Slavich, 2015), thereby making inflammation a potential *common pathway* linking stress with several disease states.

Although life stress is a strong risk factor for disease, not everyone who experiences stress gets sick. As a result, some researchers have turned to the brain to understand individual differences in how people experience stress, as well as how the brain initiates downstream biological processes that promote disease. A recent finding in this context has been the discovery that stressors involving social evaluation and rejection, which can induce experiences of "social pain," activate some of the same brain regions that are engaged by physical pain (Dedovic, Slavich, Muscatell, Irwin, & Eisenberger, 2016; Kross, Berman, Mischel, Smith, & Wager, 2011; for a review, see Eisenberger, 2012). There is also evidence that some of the same genetic factors that regulate experiences of physical pain may influence experiences of social pain (Slavich, Tartter, Brennan, & Hammen, 2014). Moreover, individual differences in neural responses to social stress in these particular brain regions predict differences in inflammatory responding to social stress (Muscatell et al., 2015; Slavich, Way, Eisenberger, & Taylor, 2010). As a result, one emerging idea is that individuals who are more neurally sensitive to social stressors may mount greater inflammatory responses to social stress (Slavich & Irwin, 2014; Slavich, O'Donovan, et al., 2010). Such a reactivity profile may be adaptive in the short term, as it can help prevent the spread of infection and accelerate wound healing and recovery. If repeatedly engaged, however, heightened neuroinflammatory responses to social stress may increase a person's risk for a number of diseases that involve inflammation (Nusslock & Miller, 2016; Slavich & Irwin, 2014).

Recent research has also begun to examine how social stressors affect the activity of the human genome (Slavich & Cole, 2013). Because people cannot detect changes in their own genomic activity, they generally experience their bodies as being biologically stable over time and across the different social and environmental circumstances they experience in daily life. In reality, though, the human genome is continually shifting its activity to coordinate biological processes that are needed to sustain life and to calibrate the body to deal with the surrounding social, physical, and microbial environment. Some of the earliest work on this topic found that living in a rural versus urban environment has a substantial effect on individuals' genomic profile (Idaghdour, Storey, Jadallah, & Gibson, 2008). Around the same time, Cole and colleagues (2007) found that more than 200 genes were differentially expressed in lonely versus nonlonely individuals. Because many of those differentially expressed genes are involved in immune system activity, including inflammatory responding and the antiviral response, these data provided some of the first indications that experiences of social stress and adversity may affect disease risk and

mortality in part by influencing some of our most basic biological processes—namely, the expression of our genes.

Lifetime Stress Exposure and Health

In addition to this research on the biological mechanisms linking stress and health, recent work has focused on understanding the implications that different forms of life stress have for disease. At a basic level, stressors can occur as acute life events, such as getting fired or finding out that a loved one has died, or as chronic difficulties, such as living in a dangerous neighborhood or having persistent financial or marital problems (Monroe & Slavich, 2016; Slavich, 2016). Research has shown that these two forms of stress have different effects (Monroe et al., 2007; Muscatell, Slavich, Monroe, & Gotlib, 2009). In addition, a small but growing body of work is showing that the impact of acute life events and chronic difficulties occurring over a person's lifespan may exert a cumulative effect on the body that has implications for the development of disease (Lupien, McEwen, Gunnar, & Heim, 2009).

The notion that stress can exert biological "wear and tear" on the body that develops over time is not new. Indeed, several theorists have proposed different models for how acute life events and chronic difficulties may accumulate and disrupt biological systems that lead to altered neural and immune system function, oxidative stress, accelerated biological aging, and ultimately different disease states and premature mortality (e.g., Graham, Christian, & Kiecolt-Glaser, 2006; Lupien et al., 2009; McEwen, 1998). What is new in this area of research, however, is the ability to measure all of the different acute life events and chronic difficulties that individuals have experienced over the life course and to relate individuals' unique lifetime stress exposure profiles to biological and clinical outcomes.

The instrument that has been developed for assessing lifetime stress exposure is called the Stress and Adversity Inventory (STRAIN). This online system enquires about 96 different types of acute life events and chronic difficulties that a person might have experienced over the life course. For each stressor that a person endorses, follow-up questions ascertain how bad the stressor was (severity), how many times the person experienced the stressor (frequency), when the stressor occurred (timing), and how long it lasted (duration). Based on this information, the STRAIN can produce 115 different stress exposure scores and life charts that enable researchers to characterize a person's experience of many different types of stressors over the lifespan. The tool has thus been helpful for advancing the conceptualization of stress, but also for documenting how lifetime stress exposure affects mental and physical health in the general population (Toussaint, Shields, Dorn, & Slavich, 2016), as well as clinical outcomes in specific disease populations (Bower et al., 2014). Looking forward, much more research is needed to understand how lifetime stress exposure increases disease risk in healthy and vulnerable populations (Myers et al., 2015). Research is also needed to elucidate the biological mechanisms that link lifetime stress exposure and health (Seo, Tsou, Ansell, Potenza, & Sinha, 2014).

Teaching Stress and Health

Understanding how stress affects health is inherently interesting for most people. The topic is especially salient for college students, though, given recent estimates suggesting that

19.3% of male students and 40.5% of female students feel “emotionally overwhelmed” by the demands imposed on them (Pryor et al., 2012). The magnitude of this issue is compounded by the fact that less than one fourth of college students who require treatment for a mental health problem seek professional help (Blanco et al., 2008). These statistics may sound alarming, but the silver lining is that a majority of individuals who experience major life stressors do not get ill. Research has begun to identify cognitive and personality factors that may make individuals more resilient to stress (Crum et al., 2013; Shields, Young Kuchenbecker, Pressman, Sumida, & Slavich, 2016; Toussaint, Shields, & Slavich, in press). Additionally, a growing body of research is demonstrating that several psychological, cognitive, and behavioral interventions may help to improve individuals’ academic performance, stress-related biological reactivity, and mental and physical health (Black & Slavich, 2016; Free et al., 2013; Regehr, Glancy, & Pitts, 2013; Yeager & Walton, 2011).

In addition, stress and health is a readily teachable topic, given that the content for courses and lectures on these issues can be culled in part from students’ personal experiences. Along these lines, we recently conducted two studies in which we aimed to enhance students’ understanding of the link between stress and health by employing a new approach to classroom instruction called *transformational teaching* (Slavich, 2005, 2006, 2009; Slavich & Zimbardo, 2012). This approach involves “creating dynamic relationships between teachers, students, and a shared body of knowledge in a way that promotes student learning and personal growth” (Slavich & Zimbardo, 2012, p. 576). According to the original formulation of transformational teaching (Slavich, 2005), teachers accomplish these instructional goals by establishing a shared vision for a course, providing modeling and mastery experiences, challenging and encouraging students, personalizing attention and feedback, creating experiential lessons that transcend the boundaries of the classroom, and promoting ample opportunities for preflection and reflection (see Slavich & Zimbardo, 2012).

Two recent studies on transformational teaching provide a blueprint for how teachers can integrate the STRAIN into a course or lecture on stress and health to teach students about these concepts (see Slavich & Toussaint, 2014). In the first of these studies, all students completed the STRAIN online, which takes approximately 20 min. Then, 2 days later, we randomly assigned half of the students to listen to a 25-min lecture on the conceptualization and assessment of stress, the content and structure of the STRAIN, and the types of stress that were most frequently reported by students (i.e., the overall, class-averaged STRAIN results, with no disclosure of personal information). Students then discussed their experiences completing the STRAIN and reflected on stress–health links in their own lives. In the second study, we randomly assigned students to complete (a) either the STRAIN or a control task and (b) either a STRAIN-specific lecture or a general lecture on stress. The main finding from these two studies was that having students complete the STRAIN before or after a lecture on stress and health significantly improved their understanding of how stress affects health. A list of suggested instructions for how teachers might integrate the STRAIN into a lecture or course on stress and health is presented in Table 1.

Summary and Conclusions

In summary, our understanding of how stress affects health has come a long way since the days of Sisyphus and Selye. Researchers now have clearer distinctions between life stress exposure and response and better frameworks for conceptualizing and defining different forms and features of life stress. This research has been very impactful, as it has highlighted that not all types of stressors are equivalent with respect to their impact on health. This work has also helped investigators elucidate psychological and biological mechanisms that might link experiences of stress with disease. Some of the most recent studies on this topic have adopted a life-course perspective on examining links between stress and health, and this approach has already proven fruitful to the extent that researchers now have an instrument for assessing lifetime stress exposure and new ideas on how adverse experiences might accumulate over time and become embedded in the brain and body to affect lifespan health. Given the relevance of this work for disease onset and progression, it is critical that students understand how stress affects health, as well as what they can do to mitigate these effects. Stress increases individuals' risk for a variety of diseases, but people also hold substantial power to reduce these effects and improve their personal and collective psychosocial well-being.

Acknowledgments

Funding

The author disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Preparation of this review was supported by National Institutes of Health grant K08 MH103443 and by a Society in Science—Branco Weiss Fellowship to George Slavich.

Biography

George M. Slavich is an associate professor of Psychiatry and Biobehavioral Sciences at UCLA and a research scientist at the Cousins Center for Psychoneuroimmunology, where he directs the UCLA Laboratory for Stress Assessment and Research. His research aims to advance the conceptualization and assessment of life stress and to elucidate psychological and biological mechanisms linking stress with disease. He developed the first online system for assessing lifetime stress exposure, called the Stress and Adversity Inventory (STRAIN); formulated the first fully integrated, multilevel theory of depression; and has helped pioneer a new field of research called *human social genomics*. In addition to research, he is deeply devoted to excellence in teaching and mentorship. Early in his career, for example, he founded the Society of Clinical Psychology's Section on Graduate Students and Early Career Psychologists, the Western Psychological Association Student Council, and the

Stanford Undergraduate Psychology Conference. He has also developed a new approach to classroom instruction called *transformational teaching*. He has received 16 major awards for research, teaching, and mentorship since 2009. These honors include the Susan Nolen-Hoeksema Early Career Research Award from the Society for a Science of Clinical Psychology, the Neal E. Miller New Investigator Award from the Academy of Behavioral Medicine Research, the Wilbert J. McKeachie Teaching Excellence Award from the Society for the Teaching of Psychology, and the Raymond D. Fowler Award for Outstanding Contribution to the Professional Development of Graduate Students from the American Psychological Association.

References

Allbutt C. Nervous diseases and modern life. Contemporary Review. 1895; 67:210–217.

Baumeister RF, Leary MR. The need to belong: Desire for interpersonal attachments as a fundamental human motivation. Psychological Bulletin. 1995; 117:497–529. Retrieved from http://dx.doi.org/10.1037/0033-2909.117.3.497. [PubMed: 7777651]

Bernstein DP, Fink L, Handelsman L, Lovejoy M, Wenzel K, Sapareto E, Gurriero J. Initial reliability and validity of a new retrospective measure of child abuse and neglect. American Journal of Psychiatry. 1994; 151:1132–1136. Retrieved from http://dx.doi.org/10.1176/ajp.151.8.1132. [PubMed: 8037246]

Black DS, Slavich GM. Mindfulness meditation and the immune system: A systematic review of randomized controlled trials. Annals of the New York Academy of Sciences. 2016; 1373:13–24. Retrieved from http://dx.doi.org/10.1111/nyas.12998. [PubMed: 26799456]

Blanco C, Okuda M, Wright C, Hasin DS, Grant BF, Liu SM, Olfson M. Mental health of college students and their non-college-attending peers: Results from the National Epidemiologic Study on Alcohol and Related Conditions. Archives of General Psychiatry. 2008; 65:1429–1437. Retrieved from http://dx.doi.org/10.1001/archpsyc.65.12.1429. [PubMed: 19047530]

Blascovich, J. Challenge, threat, and health. In: Shah, J.; Gardner, W., editors. Handbook of motivation science. New York, NY: Guilford; 2007. p. 481-493.

Bower JE, Crosswell AD, Slavich GM. Childhood adversity and cumulative life stress: Risk factors for cancer-related fatigue. Clinical Psychological Science. 2014; 2:108–115. Retrieved from http://dx.doi.org/10.1177/2167702613496243.

Brewin CR, Andrews B, Gotlib IH. Psychopathology and early experience: A reappraisal of retrospective reports. Psychological Bulletin. 1993; 113:82–98. Retrieved from http://dx.doi.org/10.1037/0033-2909.113.1.82. [PubMed: 8426875]

Brown, GW. Meaning, measurement, and stress of life events. In: Dohrenwend, BS.; Dohrenwend, BP., editors. Stressful life events: Their nature and effects. New York, NY: John Wiley; 1974. p. 217-243.

Brown, GW.; Harris, TO. Social origins of depression: A study of psychiatric disorder in women. New York, NY: The Free Press; 1978.

Brown GW, Harris TO, Hepworth C. Loss, humiliation and entrapment among women developing depression: A patient and non-patient comparison. Psychological Medicine. 1995; 25:7–21. Retrieved from http://dx.doi.org/10.1017/s003329170002804x. [PubMed: 7792364]

Brugha TS, Cragg D. The List of Threatening Experiences: The reliability and validity of a brief life events questionnaire. Acta Psychiatrica Scandinavica. 1990; 82:77–81. Retrieved from http://dx.doi.org/10.1111/j.1600-0447.1990.tb01360.x. [PubMed: 2399824]

Camus, A. The myth of Sisyphus and other essays. O'Brien, J., translator. New York, NY: Vintage; 1955.

Clark, DA.; Beck, AT. Scientific foundations of cognitive theory of depression. New York, NY: John Wiley; 1999.

Cohen S, Janicki-Deverts D, Miller GE. Psychological stress and disease. Journal of the American Medical Association. 2007; 298:1685–1687. Retrieved from http://dx.doi.org/10.1001/jama.298.14.1685. [PubMed: 17925521]

Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. Journal of Health and Social Behavior. 1983; 24:385–396. Retrieved from http://dx.doi.org/10.2307/2136404. [PubMed: 6668417]

Cole SW, Hawkley LC, Arevalo JM, Sung CY, Rose RM, Cacioppo JT. Social regulation of gene expression in human leukocytes. Genome Biology. 2007; 8:R189. Retrieved from http://dx.doi.org/10.1186/gb-2007-8-9-r189. [PubMed: 17854483]

Couzin-Frankel J. Inflammation bares a dark side. Science. 2010; 330:1621. Retrieved from http://dx.doi.org/10.1126/science.330.6011.1621. [PubMed: 21163993]

Crum AJ, Salovey P, Achor S. Rethinking stress: The role of mindsets in determining the stress response. Journal of Personality and Social Psychology. 2013; 104:716–733. Retrieved from http://dx.doi.org/10.1037/a0031201. [PubMed: 23437923]

Cutolo M, Straub RH. Stress as a risk factor in the pathogenesis of rheumatoid arthritis. Neuroimmunomodulation. 2006; 13:277–282. Retrieved from http://dx.doi.org/10.1159/000104855. [PubMed: 17709949]

Dedovic K, Slavich GM, Muscatell KA, Irwin MR, Eisenberger NI. Dorsal anterior cingulate cortex responses to repeated social evaluative feedback in young women with and without a history of depression. Frontiers in Behavioral Neuroscience. 2016; 10:64. Retrieved from http://dx.doi.org/10.3389/fnbeh.2016.00064. [PubMed: 27065828]

Dohrenwend, BP., editor. Adversity, stress, and psychopathology. New York, NY: Oxford University Press; 1998.

Dohrenwend BP. Inventorying stressful life events as risk factors for psychopathology: Toward resolution of the problem of intracategory variability. Psychological Bulletin. 2006; 132:477–495. Retrieved from http://dx.doi.org/10.1037/0033-2909.132.3.477. [PubMed: 16719570]

Eisenberger NI. The pain of social disconnection: Examining the shared neural underpinnings of physical and social pain. Nature Reviews Neuroscience. 2012; 13:421–434. Retrieved from http://dx.doi.org/10.1038/nrn3231. [PubMed: 22551663]

Epel ES, Blackburn EH, Lin J, Dhabhar FS, Adler NE, Morrow JD, Cawthon RM. Accelerated telomere shortening in response to life stress. Proceedings of the National Academy of Sciences of the United States of America. 2004; 101:17312–17315. Retrieved from http://dx.doi.org/10.1073/pnas.0407162101. [PubMed: 15574496]

Felitti VJ, Anda RF, Nordenberg D, Williamson DF, Spitz AM, Edwards V, Marks JS. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: The adverse childhood experiences (ACE) study. American Journal of Preventive Medicine. 1998; 14:245–258. Retrieved from http://dx.doi.org/10.1016/s0749-3797(98)00017-8. [PubMed: 9635069]

Free C, Phillips G, Galli L, Watson L, Felix L, Edwards P, Haines A. The effectiveness of mobile-health technology-based health behaviour change or disease management interventions for health care consumers: A systematic review. PLoS Medicine. 2013; 10:e1001362. Retrieved from http://dx.doi.org/10.1371/journal.pmed.1001362. [PubMed: 23349621]

Gilbert, P. Depression: The evolution of powerlessness. New York, NY: The Guilford Press; 1992.

Gotlib IH, Joormann J. Cognition and depression: Current status and future directions. Annual Review of Clinical Psychology. 2010; 6:285–312. Retrieved from http://dx.doi.org/10.1146/annurev.clinpsy.121208.131305.

Graham JE, Christian LM, Kiecolt-Glaser JK. Stress, age, and immune function: Toward a lifespan approach. Journal of Behavioral Medicine. 2006; 29:389–400. Retrieved from http://dx.doi.org/10.1007/s10865-006-9057-43. [PubMed: 16715331]

Hammen C. Stress and depression. Annual Review of Clinical Psychology. 2005; 1:293–319. Retrieved from http://dx.doi.org/10.1146/annurev.clinpsy.1.102803.143938.

Hammen C, Gordon D, Burge D, Adrian C, Jaenicke C, Hiroto D. Maternal affective disorders, illness, and stress: Risk for children's psychopathology. American Journal of Psychiatry. 1987; 144:736–741. Retrieved from http://dx.doi.org/10.1176/ajp.144.6.736. [PubMed: 3591993]

Holmes TH, Rahe RH. The social readjustment rating scale. Journal of Psychosomatic Research. 1967; 11:213–218. Retrieved from http://dx.doi.org/10.1016/0022-3999(67)90010-4. [PubMed: 6059863]

Holt-Lunstad J, Smith TB, Layton JB. Social relationships and mortality risk: A meta-analytic review. PLoS Medicine. 2010; 7:e1000316. Retrieved from http://dx.doi.org/10.1371/journal.pmed.1000316. [PubMed: 20668659]

Idaghdour Y, Storey JD, Jadallah SJ, Gibson G. A genome-wide gene expression signature of environmental geography in leukocytes of Moroccan Amazighs. PLoS Genetics. 2008; 4:e1000052. Retrieved from http://dx.doi.org/10.1371/journal.pgen.1000052. [PubMed: 18404217]

Kendler KS, Hettema JM, Butera F, Gardner CO, Prescott CA. Life event dimensions of loss, humiliation, entrapment, and danger in the prediction of onsets of major depression and generalized anxiety. Archives of General Psychiatry. 2003; 60:789–796. Retrieved from http://dx.doi.org/10.1001/archpsyc.60.8.789. [PubMed: 12912762]

Kendler KS, Karkowski LM, Prescott CA. Causal relationship between stressful life events and the onset of major depression. American Journal of Psychiatry. 1999; 156:837–841. Retrieved from http://dx.doi.org/10.1176/ajp.156.6.837. [PubMed: 10360120]

Kivimäki M, Virtanen M, Elovainio M, Kouvonen A, Väänänen A, Vahtera J. Work stress in the etiology of coronary heart disease—A meta-analysis. Scandinavian Journal of Work, Environment, and Health. 2006; 32:431–442. Retrieved from http://dx.doi.org/10.5271/sjweh.1049.

Kross E, Berman MG, Mischel W, Smith EE, Wager TD. Social rejection shares somatosensory representations with physical pain. Proceedings of the National Academy of Sciences of the United States of America. 2011; 108:6270–6275. Retrieved from http://dx.doi.org/10.1073/pnas.1102693108. [PubMed: 21444827]

Lamkin, DM.; Slavich, GM. Psychosocial factors and cancer. In: Miller, HL., editor. The SAGE encyclopedia of theory in psychology. first. Thousand Oaks, CA: Sage; 2016. p. 768-770.

Leary MR. Motivational and emotional aspects of the self. Annual Reviews of Psychology. 2007; 58:317–344. Retrieved from http://dx.doi.org/10.1146/annurev.psych.58.110405.085658.

Lebois LAM, Hertzog C, Slavich GM, Feldman Barrett L, Barsalou LW. Establishing the situated features associated with perceived stress. Acta Psychologica. 2016; 169:119–132. [PubMed: 27288834]

Leserman J. Role of depression, stress, and trauma in HIV disease progression. Psychosomatic Medicine. 2008; 70:539–545. Retrieved from http://dx.doi.org/10.1097/psy.0b013e3181777a5f. [PubMed: 18519880]

Loeser JD, Melzack R. Pain: An overview. Lancet. 1999; 353:1607–1609. Retrieved from http://dx.doi.org/10.1016/s0140-6736(99)01311-2. [PubMed: 10334273]

Lupien SJ, McEwen BS, Gunnar MR, Heim C. Effects of stress throughout the lifespan on the brain, behaviour and cognition. Nature Reviews Neuroscience. 2009; 10:434–445. Retrieved from http://dx.doi.org/10.1038/nrn2639. [PubMed: 19401723]

Lutgendorf SK, Slavich GM, DeGeest K, Goodheart M, Bender D, Thaker PH, Sood AK. Non-cancer life stressors contribute to impaired quality of life in ovarian cancer patients. Gynecologic Oncology. 2013; 131:667–673. Retrieved from http://dx.doi.org/10.1016/j.ygyno.2013.09.025. [PubMed: 24096110]

Maier SF. Stressor controllability and stress-induced analgesia. Annals of the New York Academy of Sciences. 1986; 467:55–72. Retrieved from http://dx.doi.org/10.1111/j.1749-6632.1986.tb14618.x. [PubMed: 3524388]

Maier SF, Watkins LR. Stressor controllability and learned helplessness: The roles of the dorsal raphe nucleus, serotonin, and corticotropin-releasing factor. Neuroscience and Biobehavioral Reviews. 2005; 29:829–841. Retrieved from http://dx.doi.org/10.1016/j.neubiorev.2005.03.021. [PubMed: 15893820]

McEwen BS. Stress, adaptation, and disease: Allostasis and allostatic load. Annals of the New York Academy of Sciences. 1998; 840:33–44. Retrieved from http://dx.doi.org/10.1111/j.1749-6632.1998.tb09546.x. [PubMed: 9629234]

Meyer, A. The life chart and the obligation of specifying positive data in psychopathological diagnosis. In: Winters, EG., editor. The collected papers of Adolf Meyer. Vol. 3. Baltimore, MD: Johns Hopkins Press; 1951. p. 52-56.Medical teaching

Monroe SM. Modern approaches to conceptualizing and measuring life stress. Annual Review of Clinical Psychology. 2008; 4:33–52. Retrieved from http://dx.doi.org/10.1146/annurev.clinpsy.4.022007.141207.

Monroe, SM.; Slavich, GM. Psychological stressors: Overview. In: Fink, G., editor. Stress: Concepts, cognition, emotion, and behavior. 1st. Cambridge, MA: Academic Press; 2016. p. 109-115.

Monroe, SM.; Slavich, GM.; Georgiades, K. The social environment and depression: The roles of life stress. In: Gotlib, IH.; Hammen, CL., editors. Handbook of depression. third. New York, NY: The Guilford Press; 2014. p. 296-314.

Monroe SM, Slavich GM, Torres LD, Gotlib IH. Major life events and major chronic difficulties are differentially associated with history of major depressive episodes. Journal of Abnormal Psychology. 2007; 116:116–124. Retrieved from http://dx.doi.org/10.1037/0021-843x.116.1.116. [PubMed: 17324022]

Murphy MLM, Slavich GM, Chen E, Miller GE. Targeted rejection predicts decreased anti-inflammatory gene expression and increased symptom severity in youth with asthma. Psychological Science. 2015; 26:111–121. Retrieved from http://dx.doi.org/10.1177/0956797614556320. [PubMed: 25564524]

Murphy MLM, Slavich GM, Rohleder N, Miller GE. Targeted rejection triggers differential pro- and anti-inflammatory gene expression in adolescents as a function of social status. Clinical Psychological Science. 2013; 1:30–40. Retrieved from http://dx.doi.org/10.1177/2167702612455743. [PubMed: 23638342]

Muscatell KA, Dedovic K, Slavich GM, Jarcho MR, Breen EC, Bower JE, Eisenberger NI. Greater amygdala activity and dorsomedial prefrontal-amygdala coupling are associated with enhanced inflammatory responses to stress. Brain, Behavior, and Immunity. 2015; 43:46–53. Retrieved from http://dx.doi.org/10.1016/j.bbi.2014.06.201.

Muscatell KA, Slavich GM, Monroe SM, Gotlib IH. Stressful life events, chronic difficulties, and the symptoms of clinical depression. Journal of Nervous and Mental Disease. 2009; 197:154–160. Retrieved from http://dx.doi.org/10.1097/nmd.0b013e318199f77b. [PubMed: 19282680]

Myers HF, Wyatt GE, Ullman JB, Loeb TB, Chin D, Prause N, Liu H. Cumulative burden of lifetime adversities: Trauma and mental health in low-SES African Americans and Latino/as. Child Psychological Trauma: Theory, Research, Practice, and Policy. 2015; 7:243–251. Retrieved from http://dx.doi.org/10.1037/a0039077.

Nusslock R, Miller GE. Early-life adversity and physical and emotional health across the lifespan: A neuroimmune network hypothesis. Biological Psychiatry. 2016; 80:23–32. Retrieved from http://dx.doi.org/10.1016/j.biopsych.2015.05.017. [PubMed: 26166230]

Paykel ES. The evolution of life events research in psychiatry. Journal of Affective Disorders. 2001; 62:141–149. Retrieved from http://dx.doi.org/10.1016/s0165-0327(00)00174-9. [PubMed: 11223102]

Pryor, JH.; Eagan, K.; Palucki Blake, L.; Hurtado, S.; Berdan, J.; Case, MH. The American freshman: National norms fall 2012. Los Angeles, CA: Higher Education Research Institute, UCLA; 2012.

Regehr C, Glancy D, Pitts A. Interventions to reduce stress in university students: A review and meta-analysis. Journal of Affective Disorders. 2013; 148:1–11. Retrieved from http://dx.doi.org/doi:10.1016/j.jad.2012.11.026. [PubMed: 23246209]

Segerstrom SC, Miller GE. Psychological stress and the human immune system: A meta-analytic study of 30 years of inquiry. Psychological Bulletin. 2004; 130:601–630. Retrieved from http://dx.doi.org/10.1037/0033-2909.130.4.601. [PubMed: 15250815]

Seligman, ME. Helplessness: On depression, development, and death. San Francisco, CA: Freeman; 1975.

Selye, H. The stress of life. 2nd. New York, NY: McGraw-Hill; 1976.

Seo D, Tsou KA, Ansell EB, Potenza MN, Sinha R. Cumulative adversity sensitizes neural response to acute stress: Association with health symptoms. Neuropsychopharmacology. 2014; 39:670–680. Retrieved from http://dx.doi.org/10.1038/npp.2013.250. [PubMed: 24051900]

Shields GS, Young Kuchenbecker S, Pressman SD, Sumida KD, Slavich GM. Better cognitive control of emotional information is associated with reduced pro-inflammatory cytokine reactivity to stress.

Stress. 2016; 19:63–68. Retrieved from http://dx.doi.org/10.3109/10253890.2015.1121983. [PubMed: 26581830]

Slavich, GM. Zinn, TE.; Saville, BK.; Williams, JL., editors. Transformational teaching. Essays from e-xcellence in teaching, 2005. 2005. Retrieved from http://www.teachpsych.org/Resources/Documents/ebooks/eit2005.pdf

Slavich, GM. On becoming a teacher of psychology. In: Irons, JG.; Beins, BC.; Burke, C.; Buskist, B.; Hevern, V.; Williams, JE., editors. The teaching of psychology in autobiography: Perspectives from exemplary psychology teachers. Washington, DC: American Psychological Association; 2006. p. 92-99.

Slavich GM. On 50 years of giving psychology away: An interview with Philip Zimbardo. Teaching of Psychology. 2009; 36:278–284. Retrieved from http://dx.doi.org/10.1080/00986280903175772.

Slavich GM. Understanding inflammation, its regulation, and relevance for health: A top scientific and public priority. Brain, Behavior, and Immunity. 2015; 45:13–14. Retrieved from http://dx.doi.org/10.1016/j.bbi.2014.10.012.

Slavich, GM. Psychopathology and stress. In: Miller, HL., editor. The SAGE encyclopedia of theory in psychology. first. Thousand Oaks, CA: Sage; 2016. p. 762-764.

Slavich GM, Cole SW. The emerging field of human social genomics. Clinical Psychological Science. 2013; 1:331–348. Retrieved from http://dx.doi.org/10.1177/2167702613478594. [PubMed: 23853742]

Slavich GM, Irwin MR. From stress to inflammation and major depressive disorder: A social signal transduction theory of depression. Psychological Bulletin. 2014; 140:774–815. Retrieved from http://dx.doi.org/10.1037/a0035302. [PubMed: 24417575]

Slavich GM, Monroe SM, Gotlib IH. Early parental loss and depression history: Associations with recent life stress in major depressive disorder. Journal of Psychiatric Research. 2011; 45:1146–1152. Retrieved from http://dx.doi.org/10.1016/j.jpsychires.2011.03.004. [PubMed: 21470621]

Slavich GM, O'Donovan A, Epel ES, Kemeny ME. Black sheep get the blues: A psychobiological model of social rejection and depression. Neuroscience and Biobehavioral Reviews. 2010; 35:39–45. Retrieved from http://dx.doi.org/10.1016/j.neubiorev.2010.01.003. [PubMed: 20083138]

Slavich GM, Tartter MA, Brennan PA, Hammen CL. Endogenous opioid system influences depressive reactions to socially painful targeted rejection life events. Psychoneuroendocrinology. 2014; 49:141–149. Retrieved from http://dx.doi.org/10.1016/j.psyneuen.2014.07.009. [PubMed: 25086307]

Slavich GM, Thornton T, Torres LD, Monroe SM, Gotlib IH. Targeted rejection predicts hastened onset of major depression. Journal of Social and Clinical Psychology. 2009; 28:223–243. Retrieved from http://dx.doi.org/10.1521/jscp.2009.28.2.223. [PubMed: 20357895]

Slavich GM, Toussaint L. Using the Stress and Adversity Inventory as a teaching tool leads to significant learning gains in two courses on stress and health. Stress and Health. 2014; 30:343–352. Retrieved from http://dx.doi.org/10.1002/smi.2523. [PubMed: 23955924]

Slavich GM, Way BM, Eisenberger NI, Taylor SE. Neural sensitivity to social rejection is associated with inflammatory responses to social stress. Proceedings of the National Academy of Sciences of the United States of America. 2010; 107:14817–14822. Retrieved from http://dx.doi.org/10.1073/pnas.1009164107. [PubMed: 20679216]

Slavich GM, Zimbardo PG. Transformational teaching: Theoretical underpinnings, basic principles, and core methods. Educational Psychology Review. 2012; 24:569–608. Retrieved from http://dx.doi.org/10.1007/s10648-012-9199-6. [PubMed: 23162369]

Toussaint L, Shields G, Dorn G, Slavich GM. Effects of lifetime stress exposure on mental and physical health in young adulthood: How stress degrades and forgiveness protects health. Journal of Health Psychology. 2016; 21:1004–1014. Retrieved from http://dx.doi.org/10.1177/1359105314544132. [PubMed: 25139892]

Toussaint, LL.; Shields, GS.; Slavich, GM. Forgiveness, stress, and health: A 5-week dynamic parallel process study. Annals of Behavioral Medicine. in pressRetrieved from http://dx.doi.org/10.1007/s12160-016-9796-6

Weiner, H. Perturbing the organism: The biology of stressful experience. Chicago: University of Chicago Press; 1992.

Weiss, JM.; Goodman, PG. Neurochemical mechanisms underlying stress-induced depression. In: Field, TM.; McCabe, PM.; Schneiderman, N., editors. Stress and coping. Hillsdale, NJ: Erlbaum; 1985. p. 93-116.

Yeager DS, Walton GM. Social-psychological interventions in education: They're not magic. Review of Educational Research. 2011; 81:267–301. Retrieved from http://dx.doi.org/10.3102/0034654311405999.

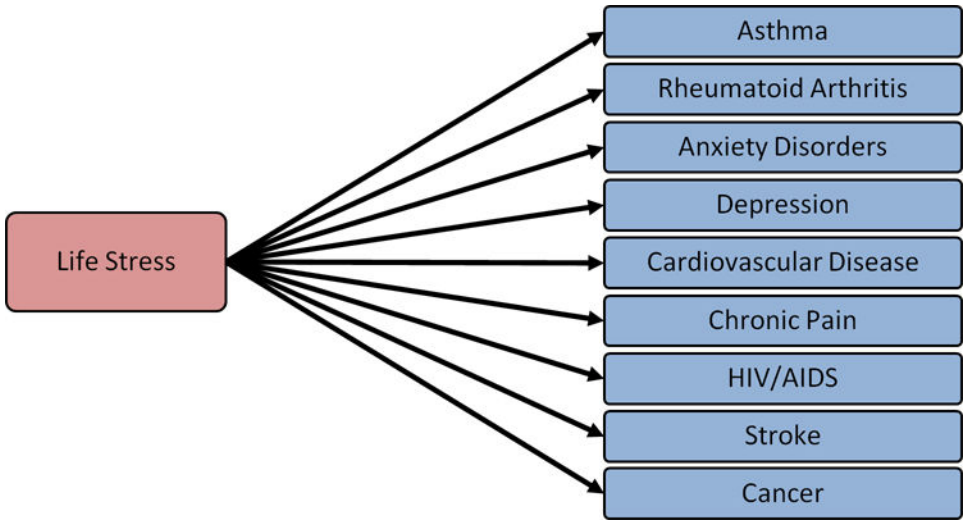

Figure 1.

Life stress and health. Life stress has been implicated in the development, maintenance, or exacerbation of several major mental and physical health conditions, in addition to accelerated biological aging and premature mortality.

Table 1

Steps for Integrating the STRAIN into a Course or Lecture on Stress and Health Using Methods from Transformational Teaching.

Steps	Description
1.	Request an educational license to use the STRAIN in an upcoming lecture or course by emailing license@lifestresstest.com.
2.	Early on, establish a vision for the lesson by telling students that they will be working together to understand how life experiences "get under the skin" to affect health and that each student's input will be critical for advancing the group's collective understanding of the topic.
3.	Prior to the class meeting on the topic, have students write a *preflection letter* in which they discuss their thoughts or feelings about stress and health, their personal experiences with the topic, or ways in which they believe the assignment could affect them. This letter can be kept private, discussed with a partner, posted in an online forum, or shared in class, depending on the goals of the exercise and nature of the class. Alternatively, instructors can engage students in a guided *preflection discussion* on stress and health, in which students describe their attitudes or feelings toward a question or problem on the topic; their proposed strategies for examining the issue or tackling a personal or public health problem in this context; their past experiences or strategies for dealing with stress; or the ways in which they expect the activity will affect them.
4.	Have students take the STRAIN online by logging into the system, either during class or while they are at home (average time of completion: 20 min).
5.	Give a lecture on stress and health that contextualizes the problem, reviews main concepts and terminology, describes how stress is related to different mental and physical health problems, identifies possible psychological and biological mechanisms linking stress and disease, discusses interventions that have been found to improve resilience or reduce stress-related health problems, and summarizes steps that students can take to manage stress in their lives and improve their psychological and physical well-being.
6.	Have students *critically reflect* on the lecture or on completing the STRAIN, either alone or in a group. As reviewed in Slavich and Zimbardo (2012), numerous activities have been developed for this purpose, including journaling, guided reading, guided discussion, "microlabs," structured debating, and "fishbowl."
7.	Give students the option to meet with you in private to review the topic; identify points of understanding or difficulties with understanding; discuss personal strengths and weaknesses related to the topic; identify and challenge personal *habits of mind* or points of view; develop a personalized vision for the future, a tailored learning plan, or exercises that will enable students to practice new skills and work toward achieving their ideal self; or create a personalized *intentional change plan* (see Slavich & Zimbardo, 2012).
8.	Finally, in the next lecture, return to the overarching vision for the lesson. Review the main take-home messages, and underscore how each student can take personal responsibility for reducing their stress levels and improving their health by continuing to apply the stress management strategies that were discussed during the lesson. Encourage students to assist one another in developing a collective culture that celebrates human health and wellness.

Note. STRAIN = Stress and Adversity Inventory