



Stress and Health



Stress refers primarily to the experiences people have when they face challenging events or conditions that they feel exceed their resources for coping.

Stressor or hardship refers to the challenging events or conditions, including not only dramatic short-term threats or challenges, but also the kinds of ongoing, everyday hassles that strain a person's ability to cope.

The term stress response refers to the set of behavioral and physiologic processes provoked by a stressor.

1. Introduction

We're all familiar with the feeling of being overwhelmed or struggling to maintain balance and perform adequately in the face of too many demands, responsibilities or uncertainties. When we feel like this, we say we are "stressed"—understanding intuitively that the accompanying worry, disturbed sleep and inability to relax can threaten our health and well-being. For some of us, the stress we experience is temporary—for example, when we feel concerned about a deadline at work. For others, stress may be related to a longer-term hardship, such as caring for a seriously ill family member. These types of stress affect us differently, however, than the stress people experience when they face multiple, everyday challenges that exceed their capacities to cope.

Research over the past several decades has revealed dramatic differences in important child and adult health outcomes based on social factors such as income and wealth, education, and racial or ethnic group.¹⁻³ These differences in health begin early in life—even before birth—and accumulate over lifetimes and across generations, and a growing body of evidence indicates that the effects of stress play a fundamental role. This issue brief provides an overview of current knowledge about the links between stress and health, and examines how social advantage or disadvantage can influence people's experiences of stress. Understanding these relationships can help inform and guide policies in all of the sectors that influence health.





2. Stress is linked with many different health outcomes

Exposure to stress and stressful conditions has been repeatedly implicated in a wide array of health outcomes, from the beginning of life on:

- Some evidence suggests that stressful experiences during pregnancy may increase a woman’s risk of delivering her baby preterm (before 37 completed weeks of gestation);⁵⁻⁸ chronic exposure to stressful conditions during childhood or as an adult before becoming pregnant may increase the risk of preterm birth as well.^{5, 8, 9} This elevated risk can have long-lasting effects for the baby: preterm birth is a powerful risk factor not only for infant mortality and cognitive, behavioral and physical problems in childhood, but also for serious chronic disease—including heart disease, hypertension and diabetes—later in life.⁸
- During childhood and adolescence, stress appears to increase risk of poorer mental and physical health.¹⁰⁻¹² For example, research examining a range of individual and family stressors such as family disruption and conflict, parents’ mental health problems, and financial strain indicates that children and adolescents exposed to higher levels of stress have increased risks of being overweight and/or obese¹³⁻¹⁶ even after considering other factors such as age, racial or ethnic group, parents’ weight or family income. In addition, a growing body of evidence links stressful childhood experiences with increased risk of serious adult health problems including heart disease and diabetes.¹⁷⁻²⁰
- Among adults, exposure to work-related and other stressors has been linked in multiple studies with cardiovascular illness such as coronary heart disease and heart attacks, as well as with cardiovascular disease risk factors.²¹⁻²⁵

“Good” and “bad” stress: Meeting and overcoming a challenge may actually have positive health effects by leading to growth, adaptation and learning that promote a person’s resilience and capacity for coping with future hardships.

In contrast, the health-damaging effects of stress are more likely to occur when a person experiences repeated or ongoing exposure to stressors in aspects of everyday life over which he or she has limited control.

3. What explains the links between stress and health?

STRESS AFFECTS HEALTH WHEN A PERCEIVED CHALLENGE EXCEEDS A PERSON’S ABILITY TO COPE

This is especially the case when the imbalance between stressful conditions and available coping resources is severe and/or chronic. Depending on how the imbalance is resolved, these effects are not always negative. For example, meeting and overcoming a challenge may actually have positive health effects by leading to growth, adaptation and learning that promote a person’s resilience and capacity for coping with future hardships. In contrast, the health-damaging effects of stress are more likely to occur when a person experiences ongoing or chronic exposure to stressors in aspects of everyday life over which he or she has limited control—for example, trying to juggle both family and job commitments without a flexible work schedule or personal and sick leave.^{26, 27} This type of chronic stress leads to a cascade of negative behavioral, cognitive, physiologic and neurologic changes over time that increase vulnerability to poor health.⁴

STRESS CAN INFLUENCE HEALTH THROUGH PATHWAYS INVOLVING BEHAVIORS

The links between stress and health can be explained at least in part through related behaviors. For example, exposure to stressful conditions has been associated with several different measures of tobacco use,²⁸⁻³⁰ including onset of smoking in adolescence,³¹ and with alcohol or other substance abuse and/or dependence.^{32, 33} While findings on the relationship between stress and diet or physical activity have been less consistent, evidence suggests that stressful experiences are linked with over-eating and





unhealthy food choices,³⁴ binge eating,³⁵⁻³⁷ and less frequent exercise and higher-fat diets among working men and women.³⁸

STRESS MAY ALSO SHAPE HEALTH MORE DIRECTLY THROUGH COMPLEX PHYSIOLOGIC MECHANISMS

Over the past two decades, there has been a dramatic growth in knowledge about the biological processes through which stressful experiences may more directly lead to disease and premature death (before age 75). Several areas within the brain mediate the body’s stress-related processes, playing key roles both in assessing whether events or circumstances are threatening and in regulating the body’s responses through complex interactions between two main physiologic systems: the *neuroendocrine system*, which includes the brain and the hormonal systems directly activated by the brain, and the *immune system*.^{4, 39, 40}

The brain plays the key role both in assessing whether external events or circumstances are threatening and in regulating the body’s responses.

THE SCIENCE OF STRESS

The body’s responses to stress involve complex interactions between two main physiologic systems: the neuroendocrine system, which includes the brain and the hormonal systems directly activated by the brain, and the immune system.

Neuroendocrine processes involved in the stress response.

Two components of the neuroendocrine system play major roles in the stress response:

- The hypothalamic-pituitary-adrenal (HPA) axis: As shown in Figure 1, the body’s stress responses begin in the brain, with the detection of a threat or challenge. Within seconds, the hypothalamus triggers a series of reactions that result in the production of a type of steroid hormones called glucocorticoids, including cortisol. Cortisol has major effects on multiple organs and systems that can result in altered regulation and aging of the immune system, changes in the brain, and metabolic disturbances contributing to cardiovascular disease risk.^{41, 42}
- The sympathetic nervous system: Perceiving an external threat also activates the sympathetic branch of the autonomic nervous system to release substances called catecholamines—including epinephrine, also called adrenaline, and norepinephrine, also called noradrenaline—from the inner portion, or medulla, of the adrenal gland. These catecholamines act to increase heart rate and blood pressure, mobilize energy stores from the liver, and direct blood flow away from the skin, digestive tract and kidneys to the heart, brain and skeletal muscles.⁴³

Immune processes involved in the stress response.

The primary role of the immune system is to defend the body against infection through several mechanisms, including inflammation, with effects that may or may not be beneficial to health.⁴² Ongoing exposure to stressful conditions appears to produce significant and long-lasting changes in immune processes;^{39, 44-47} these changes have been linked with multiple adverse health effects.^{39, 45, 46, 48, 49} The immune system appears to be most susceptible to the effects of stress both early and late in life. Animal research suggests that stress during the prenatal period and infancy makes the young more vulnerable to the effects of toxic substances and infectious diseases.⁵⁰ Stress early in life—particularly when experienced on a chronic basis—may influence the immune system’s ability to respond to stress in adulthood.^{51, 52} Chronic stress also may exacerbate changes in the immune response associated with aging.⁴⁷

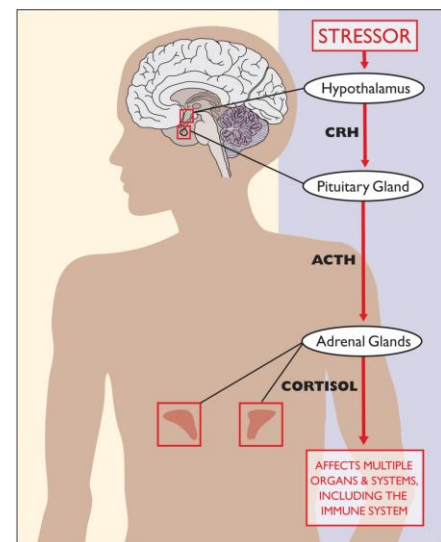


Figure 1. A simplified illustration of the hypothalamic-pituitary-adrenal (HPA) axis of the stress response.

(CRH = corticotrophin-releasing hormone; ACTH = adrenocorticotropic hormone)





VARIABILITY IN RESPONSES TO STRESS: BOTH BIOLOGY AND CONTEXT MATTER

Two individuals faced with the same external stressor may react very differently. Although genetic predisposition can play a role,⁵³ evidence indicates that some people are more vulnerable than others to the health-harming effects of stress as a result of both their own individual sensitivity to stressors and the frequency and kinds of stress they encounter. For example, one recent study found that children who were more biologically sensitive to stressful conditions coped more effectively than their less stress-reactive peers in families with low levels of stress, but fared worse in families facing greater financial and social stressors.⁵⁴ Social support from family, friends and co-workers may also relieve the health-damaging effects of stress by helping people cope more effectively with stressful situations.⁵⁵⁻⁵⁷ For example, higher levels of social support among coworkers in stressful working environments have been linked with lower rates of absenteeism due to mental health problems and illness.^{58, 59}

Chronic exposure to stressful everyday hardships can be more damaging to health than an acute stress-inducing experience or event, even when the latter is more dramatic.

CHRONIC EXPOSURE TO STRESSFUL CONDITIONS CAN BE PARTICULARLY DAMAGING TO HEALTH, ESPECIALLY WHEN IT BEGINS EARLY IN LIFE

To our prehistoric ancestors who regularly encountered immediate physical threats requiring them to react with relatively short spurts of superior mental and physical performance, the physiological “fight or flight” response represented an evolutionary advantage. In comparison, the challenges and hardships most people today face in their everyday lives are likely to be both less dramatic and more persistent. Acute experiences of stress due to isolated dramatic events can certainly have health impacts; for example, one study found a threefold increase in heart attacks and a near-doubling in stroke incidence after an earthquake in Japan.⁶⁰ However, current research indicates that prolonged activation of the stress response due to chronic stressors is more likely to lead to poor health.³⁹

Chronic stress—particularly early in life—can result in long-term damage in multiple body organs and systems and can affect the ability to respond to stress, impairing the body’s ability to appropriately “switch off” the stress response later in life.⁶¹⁻⁶³ Allostatic load, or the wear and tear on the body’s systems related to prolonged or excessive stress, is one explanation for the health-damaging effects of chronic stress and is measured using multiple biological markers.⁶⁴ It also has been linked with health-damaging behaviors, including poor sleeping and eating patterns.

4. The links between social disadvantage and stress

DISADVANTAGE RELATED TO LIMITED SOCIAL AND ECONOMIC RESOURCES CREATES STRESS

Striking differences in health and life expectancy have been repeatedly seen in the United States and other countries based on differences in educational attainment, occupational ranking, income and accumulated wealth.⁶⁵⁻⁷⁰ These differences are not just between groups at the top and bottom of the socioeconomic ladder, but instead follow a stepwise pattern: health improves incrementally with increasing levels of social and economic advantage.^{1, 71-75}

How could stress contribute to the links between relative socioeconomic advantage and health? Does it make intuitive sense that people at the bottom of the socioeconomic ladder experience greater levels of stress than those at the top? One could argue, for example, that executives and professionals, who typically have a great deal of

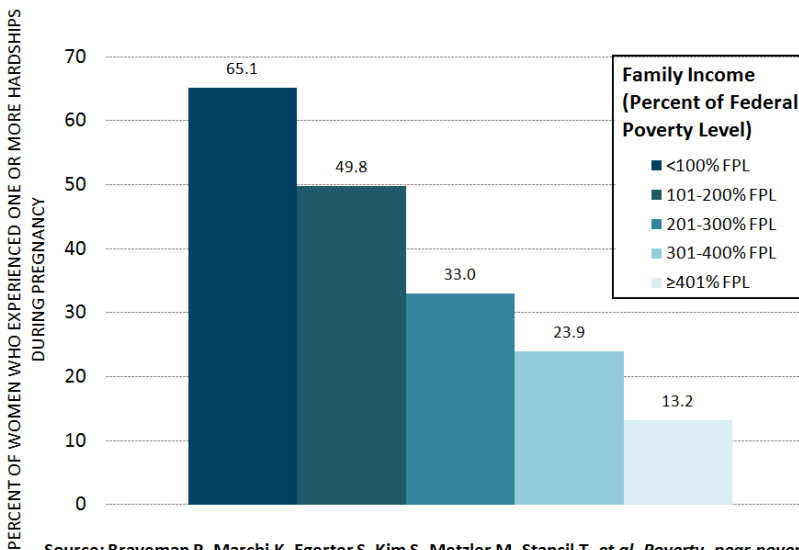




responsibility and are under near-constant pressure to perform well at challenging tasks, encounter high levels of stress on a daily basis. Over the past 15 to 20 years, however, we have learned that certain kinds of stress are more damaging to the body than others. The kinds of challenges faced by a person in a high-status job—who typically has support, resources and a high degree of control over her or his work—may not result in the wear-and-tear on bodily systems provoked by the kind of chronic stress experienced by someone in a low-status job with limited support and resources and relatively little control over how he or she works.⁷⁶⁻⁷⁸

People with greater socioeconomic advantage—with more education, higher incomes and/or greater wealth, for example—may be more likely to experience stress in ways that actually have beneficial effects on their health; this can occur when their own sense of being able to successfully meet and resolve the challenges they encounter is reinforced. In contrast, those with less education and lower incomes typically face more frequent and numerous stressors in many aspects of their lives, while at the same time having more limited social and material resources for coping. For example:

- As seen in Figure 2, the percentage of childbearing women in California who experienced one or more major hardships (including economic hardship, food insecurity, lack of practical and emotional support, separation/divorce, homelessness, her own or her partner’s job loss, her own or her partner’s incarceration, and domestic violence) during pregnancy increased with decreasing levels of family income.⁷⁹ (See Figure 2.)



Source: Braveman P, Marchi K, Egerter S, Kim S, Metzler M, Stancil T, et al. Poverty, near-poverty, and hardship around the time of pregnancy. *Matern Child Health J.* 2009;14(1):20-35.

Social disadvantage related to having less education, income and/or wealth means facing more stressful living and working conditions, every day and over time, while having fewer resources to cope.

Figure 2. Less income, more chance of stressful events during pregnancy. The percentage of childbearing women in California who experienced one or more major hardships during pregnancy increased with decreasing levels of family income.

- A study of rural white children found that children in low-income families were exposed to more physical hardships (including substandard housing, noise and crowding) and psychosocial hardships (such as family turmoil, early childhood separation and community violence) than those in middle-income families.⁸⁰
- Financial difficulties put families with limited means under greater stress, contributing to family disruption.⁸¹ Lower levels of both family income and educational attainment have been associated with greater financial, marital and parental stress among U.S. adults over age 25.⁸²





- Several studies have found that lower family incomes, assets or educational attainment correspond with higher measures of negative or traumatic life events or chronic stress.⁸³⁻⁸⁶

Stress related to chronic socioeconomic disadvantage can have long-term effects. Stressful experiences—including both ongoing everyday hassles and more acute events like job loss, with inadequate resources to cope—tend to compound to create higher levels of stress over a person’s lifetime.⁸⁷ For example, a person with lower educational attainment typically has more limited employment opportunities, increasing the likelihood that he or she experiences stress related to work that is lower-paying and less secure, combines high demands with low control (Figure 3) and provides less flexibility for balancing work and family obligations. These work-related stressors, in turn, can translate into greater stress for everyone in the family, particularly children. As noted above, chronic exposure—particularly in childhood—to the kinds of stressful conditions related to socioeconomic disadvantage may disrupt regulation of the body’s physiologic responses to stress, leading to impaired functioning with potentially lifelong adverse impacts on health.

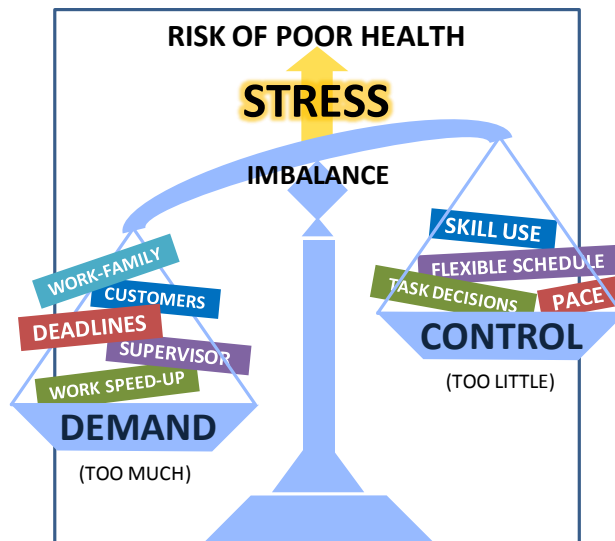


Figure 3. Working conditions that combine high demands with low levels of control are particularly stressful, and have been linked to physical and mental health problems.

STRESS MAY PLAY A KEY ROLE IN HEALTH DISPARITIES ACROSS RACIAL OR ETHNIC GROUPS

Dramatic racial and ethnic disparities in health have repeatedly been observed in the United States, even after taking into account socioeconomic differences between groups; for many health outcomes, African Americans as a group fare worse than whites at every socioeconomic level.^{88, 89} Many researchers believe that stress related to living in a society with a legacy of racial discrimination is a major factor in explaining poorer health outcomes among members of minority racial or ethnic groups.⁹⁰ Even for someone who has not personally faced major incidents of overt bias, the constant awareness that he or she—or a loved one—might be unfairly perceived or treated based on race can be a potent source of chronic stress.⁹¹ Even after considering other risk factors, perceptions of racial-ethnic discrimination have been linked with poorer mental and physical health outcomes,⁹² including adverse birth outcomes,⁵ indicating that stress-related pathways are likely to be involved. One study examining physiologic markers of stress found that, at every age and in both poor and non-poor households, blacks had higher levels of allostatic load—evidence of bodily wear-and-tear associated with chronic stress (see above)—than whites.⁹³





5. Implications for programs and policies to improve health and reduce health disparities

What can be done to reduce the adverse effects of stress on health, particularly among those at highest risk? Both public and private-sector programs and policies—including, but not limited to, those within the health sector—could have profound effects on the levels of stress experienced by many Americans, both by reducing stressful conditions, particularly in childhood, and by increasing people’s capacities to meet the challenges in their lives.

The health sector has traditionally focused on buffering the effects of stress. In the clinical setting, ways to help people cope with stress included supportive counseling, sometimes in combination with psychoactive medications. Policies designed to remove financial, cultural and geographic barriers to supportive counseling or medication could help narrow stress-related health disparities.

Some innovative health-sector interventions have focused more broadly on interrupting the health-harming effects of stress by increasing people’s capacity to manage stress. For example, the Nurse-Family Partnership provides low-income, first-time parents with social support and education to help them manage the stressors in their lives constructively and avoid health-damaging behaviors like smoking that they might otherwise rely on to cope with stress.⁹⁴

Other programs have focused on integrating social and medical services in medical care settings, with the goal of actually reducing the number and severity of stressors experienced by low-income families with children. For example, the Medical-Legal Partnership provides onsite access to legal assistance at more than 225 hospitals and





health centers nationally.⁹⁵ In addition, HealthLeads partners trained undergraduate volunteers with medical providers in urban clinics to connect low-income families with social service resources such as food, housing and heating assistance; nearly 7,000 families in six cities were served during 2010.⁹⁶

Many relevant strategies outside of the health sector have also focused on reducing stressful conditions themselves. Many of these strategies are featured in other issue briefs in this series—focusing, for example, on early childhood conditions, economic resources, education, work, neighborhood conditions and housing and their links with health—and in the final report and recommendations of the RWJF Commission to Build a Healthier America.⁹⁷

For example, programs focused on early childhood education and increasing educational and employment opportunities can translate into greater social and economic resources to cope with life's challenges. Doing so not only reduces stress, but also increases people's capacity to meet challenges. Improving access to affordable medical care could reduce a major source of stress and economic insecurity for many American families. Safety nets—including unemployment benefits, tax credits, cash assistance, and subsidized housing, child care and transportation benefits to low-income working families—can buffer some of the stress experienced by families faced with economic challenges. In both the public and private sectors, family-friendly workplace programs and policies—including flexible scheduling, family leave, breastfeeding support and onsite or subsidized childcare—can reduce stress among employees as they seek to balance their work and family responsibilities. For example, Results Only Work Environment (ROWE) focuses on the productivity of employees' work efforts, rather than on time at work, and allows individual workers and their teams—rather than supervisors—to set work hours and schedules. Employees reported significant improvements in control over work time, work-family balance and health-related behaviors and outcomes.⁹⁸

6. Conclusion

The growing scientific knowledge about the links between stress and health has tremendous practical significance. Understanding these links is essential for raising awareness among public and private policymakers about the importance of policies and programs that can help make life less stressful, particularly for those who experience the most stress and are most vulnerable to its health-damaging effects. While much remains to be learned, current knowledge makes it clear that addressing the effects of stress—particularly chronic stress, and particularly among children—can play a critical role in realizing the health potential of all Americans.





ABOUT THE ROBERT WOOD JOHNSON FOUNDATION

The Robert Wood Johnson Foundation focuses on the pressing health and health care issues facing our country. As the nation's largest philanthropy devoted exclusively to improving the health and health care of all Americans, the Foundation works with a diverse group of organizations and individuals to identify solutions and achieve comprehensive, meaningful and timely change. For 40 years, the Foundation has brought experience, commitment, and a rigorous, balanced approach to the problems that affect the health and health care of those it serves. When it comes to helping Americans lead healthier lives and get the care they need, the Foundation expects to make a difference in your lifetime.

ABOUT THE COMMISSION TO BUILD A HEALTHIER AMERICA

The Robert Wood Johnson Foundation Commission to Build a Healthier America was a national, independent, non-partisan group of leaders that released 10 recommendations to dramatically improve the health for all Americans. www.commissiononhealth.org

ABOUT THIS ISSUE BRIEF SERIES

This issue brief is one in a series of twelve on the social determinants of health. The series began as a product of the Robert Wood Johnson Foundation Commission to Build a Healthier America.

CREDITS: LEAD AUTHORS

University of California, San Francisco

Center on Disparities in Health

Susan Egerter, Ph.D.

Paula Braveman, M.D., M.P.H.

Colleen Barclay, M.P.H.





REFERENCES

1. Braveman PA, Cubbin C, Egerter S, Williams DR, Pamuk E. Socioeconomic disparities in health in the United States: What the patterns tell us. *Am J Public Health* 2010 100(S1).
2. Pollack CE, Chideya S, Cubbin C, Williams B, Dekker M, Braveman P. Should health studies measure wealth? A systematic review. *Am J Prev Med* 2007;33(3):250-64.
3. Pamuk E, Makuc D, Keck K, Reuban C, Lochner K. Health, United States, 1998 with Socioeconomic Status and Health Chartbook. . Hyattsville, MD: National Center for Health Statistics; 1998.
4. McEwen BS, Gianaros PJ. Central role of the brain in stress and adaptation: links to socioeconomic status, health, and disease. *Ann N Y Acad Sci* 2010;1186:190-222.
5. Dominguez TP, Denkel-Schetter C, Glynn LM, Hobel C, Sandman CA. Racial differences in birth outcomes: The role of general, pregnancy, and racism stress. *Health Psychology* 2008;27(2):194-203.
6. Dunkel Schetter C. Psychological science on pregnancy: stress processes, biopsychosocial models, and emerging research issues. *Annu Rev Psychol* 2011;62:531-58.
7. Hobel CJ, Goldstein A, Barrett ES. Psychosocial stress and pregnancy outcome. *Clin Obstet Gynecol* 2008;51(2):333-48.
8. Institute of Medicine, Committee on Understanding Premature Birth and Assuring Healthy Outcomes, Board on Health Sciences Policy. *Preterm Birth: Causes, Consequences, and Prevention*. Washington, DC: The National Academies Press; 2007.
9. Lu MC, Halfon N. Racial and ethnic disparities in birth outcomes: a life-course perspective. *Matern Child Health J* 2003;7(1):13-30.
10. Larson K, Russ SA, Crall JJ, Halfon N. Influence of multiple social risks on children's health. *Pediatrics* 2008;121(2):337-44.
11. Schilling EA, Aseltine RH, Gore S. The impact of cumulative childhood adversity on young adult mental health: measures, models, and interpretations. *Soc Sci Med* 2008;66(5):1140-51.
12. Stevens GD. Gradients in the health status and developmental risks of young children: the combined influences of multiple social risk factors. *Matern Child Health J* 2006;10(2):187-99.
13. Garasky S, Stewart SD, Gundersen C, Lohman BJ, Eisenmann JC. Family stressors and child obesity. *Soc Sci Res* 2009;38(4):755-66.
14. Gundersen C, Lohman BJ, Garasky S, Stewart S, Eisenmann J. Food security, maternal stressors, and overweight among low-income US children: results from the National Health and Nutrition Examination Survey (1999-2002). *Pediatrics* 2008;122(3):e529-40.
15. Lohman BJ, Stewart S, Gundersen C, Garasky S, Eisenmann JC. Adolescent overweight and obesity: links to food insecurity and individual, maternal, and family stressors. *J Adolesc Health* 2009;45(3):230-7.
16. van Jaarsveld CH, Fidler JA, Steptoe A, Boniface D, Wardle J. Perceived stress and weight gain in adolescence: a longitudinal analysis. *Obesity (Silver Spring)* 2009;17(12):2155-61.
17. Bauer AM, Boyce WT. Prophecies of childhood: how children's social environments and biological propensities affect the health of populations. *Int J Behav Med* 2004;11(3):164-75.
18. Center on the Developing Child at Harvard University. A science-based framework for early childhood policy: Using evidence to improve outcomes in learning, behavior, and health for vulnerable children. 2007 May 14, 2008]; Available from: <http://www.developingchild.harvard.edu>
19. Lehman BJ, Taylor SE, Kiefe CI, Seeman TE. Relationship of early life stress and psychological functioning to blood pressure in the CARDIA study. *Health Psychol* 2009;28(3):338-46.
20. Taylor SE, Lehman BJ, Kiefe CI, Seeman TE. Relationship of early life stress and psychological functioning to adult C-reactive protein in the coronary artery risk development in young adults study. *Biol Psychiatry* 2006;60(8):819-24.
21. Belkic KL, Landsbergis PA, Schnall PL, Baker D. Is job strain a major source of cardiovascular disease risk? *Scand J Work Environ Health* 2004;30(2):85-128.
22. Chandola T, Brunner E, Marmot M. Chronic stress at work and the metabolic syndrome: prospective study. *Bmj* 2006;332(7540):521-5.





23. Marmot M, Bosma H, Hemingway H, Brunner E, Stansfeld S. Contribution of job control and other risk factors to social variations in coronary heart disease incidence. *Lancet* 1997;350:235-239.
24. Ohlin B, Nilsson PM, Nilsson JA, Berglund G. Chronic psychosocial stress predicts long-term cardiovascular morbidity and mortality in middle-aged men. *Eur Heart J* 2004;25(10):867-73.
25. Rosengren A, Hawken S, Ounpuu S, Sliwa K, Zubaid M, Almahmeed WA, et al. Association of psychosocial risk factors with risk of acute myocardial infarction in 11119 cases and 13648 controls from 52 countries (the INTERHEART study): case-control study. *Lancet* 2004;364(9438):953-62.
26. Boden LI. Running on empty: families, time, and workplace injuries. *Am J Public Health* 2005;95(11):1894-7.
27. Frone MR. Work-family conflict and employee psychiatric disorders: the National Comorbidity Survey. *Journal of Applied Psychology* 2000;85(6):888-95.
28. Kouvonen A, Kivimaki M, Virtanen M, Pentti J, Vahtera J. Work stress, smoking status, and smoking intensity: an observational study of 46,190 employees. *J Epidemiol Community Health* 2005;59(1):63-9.
29. Manning BK, Catley D, Harris KJ, Mayo MS, Ahluwalia JS. Stress and quitting among African American smokers. *J Behav Med* 2005;28(4):325-33.
30. Weaver K, Campbell R, Mermelstein R, Wakschlag L. Pregnancy smoking in context: the influence of multiple levels of stress. *Nicotine Tob Res* 2008;10(6):1065-73.
31. Finkelstein DM, Kubzansky LD, Goodman E. Social status, stress, and adolescent smoking. *J Adolesc Health* 2006;39(5):678-85.
32. Andersen SL, Teicher MH. Desperately driven and no brakes: developmental stress exposure and subsequent risk for substance abuse. *Neurosci Biobehav Rev* 2009;33(4):516-24.
33. Lloyd DA, Turner RJ. Cumulative lifetime adversities and alcohol dependence in adolescence and young adulthood. *Drug Alcohol Depend* 2008;93(3):217-26.
34. Epel ES. Psychological and metabolic stress: a recipe for accelerated cellular aging? *Hormones (Athens)* 2009;8(1):7-22.
35. Crowther JH, Sanftner J, Bonifazi DZ, Shepherd KL. The role of daily hassles in binge eating. *Int J Eat Disord* 2001;29(4):449-54.
36. Harrington EF, Crowther JH, Henrickson HC, Mickelson KD. The relationships among trauma, stress, ethnicity, and binge eating. *Cultur Divers Ethnic Minor Psychol* 2006;12(2):212-29.
37. Wolff GE, Crosby RD, Roberts JA, Wittrock DA. Differences in daily stress, mood, coping, and eating behavior in binge eating and nonbinge eating college women. *Addict Behav* 2000;25(2):205-16.
38. Ng DM, Jeffery RW. Relationships between perceived stress and health behaviors in a sample of working adults. *Health Psychol* 2003;22(6):638-42.
39. Cohen S, Janicki-Deverts D, Miller GE. Psychological stress and disease. *JAMA* 2007;298(14):1685-7.
40. McEwen BS. Physiology and neurobiology of stress and adaptation: central role of the brain. *Physiol Rev* 2007;87(3):873-904.
41. McEwen BS. Stressed or stressed out: what is the difference? *J Psychiatry Neurosci* 2005;30(5):315-8.
42. Sorrells SF, Sapolsky RM. An inflammatory review of glucocorticoid actions in the CNS. *Brain Behav Immun* 2007;21(3):259-72.
43. Piazza JR, Almeida DM, Dmitrieva NO, Klein LC. Frontiers in the use of biomarkers of health in research on stress and aging. *J Gerontol B Psychol Sci Soc Sci* 2010;65(5):513-25.
44. Bauer ME, Jeckel CM, Luz C. The role of stress factors during aging of the immune system. *Ann N Y Acad Sci* 2009;1153:139-52.
45. Elenkov IJ. Glucocorticoids and the Th1/Th2 balance. *Ann N Y Acad Sci* 2004;1024:138-46.
46. Elenkov IJ, Chrousos GP. Stress hormones, proinflammatory and antiinflammatory cytokines, and autoimmunity. *Ann N Y Acad Sci* 2002;966:290-303.





47. Gouin JP, Hantsoo L, Kiecolt-Glaser JK. Immune dysregulation and chronic stress among older adults: a review. *Neuroimmunomodulation* 2008;15(4-6):251-9.
48. Cobb JM, Steptoe A. Psychosocial stress and susceptibility to upper respiratory tract illness in an adult population sample. *Psychosom Med* 1996;58(5):404-12.
49. Kiecolt-Glaser JK, Preacher KJ, MacCallum RC, Atkinson C, Malarkey WB, Glaser R. Chronic stress and age-related increases in the proinflammatory cytokine IL-6. *Proc Natl Acad Sci U S A* 2003;100(15):9090-5.
50. Bellinger DL, Lubahn C, Lorton D. Maternal and early life stress effects on immune function: relevance to immunotoxicology. *J Immunotoxicol* 2008;5(4):419-44.
51. Graham JE, Christian LM, Kiecolt-Glaser JK. Stress, age, and immune function: toward a lifespan approach. *J Behav Med* 2006;29(4):389-400.
52. Wyman PA, Moynihan J, Eberly S, Cox C, Cross W, Jin X, et al. Association of family stress with natural killer cell activity and the frequency of illnesses in children. *Arch Pediatr Adolesc Med* 2007;161(3):228-34.
53. McEwen BS. Central effects of stress hormones in health and disease: Understanding the protective and damaging effects of stress and stress mediators. *Eur J Pharmacol* 2008;583(2-3):174-85.
54. Obradovic J, Bush NR, Stamperdahl J, Adler NE, Boyce WT. Biological sensitivity to context: the interactive effects of stress reactivity and family adversity on socioemotional behavior and school readiness. *Child Dev* 2010;81(1):270-89.
55. Cohen S, Wills TA. Stress, social support, and the buffering hypothesis. *Psychological Bulletin* 1985;98(2):310-357.
56. Lepore SJ, Allen KA, Evans GW. Social support lowers cardiovascular reactivity to an acute stressor. *Psychosom Med* 1993;55(6):518-524.
57. Uchino BN. Social support and health: a review of physiological processes potentially underlying links to disease outcomes. *J Behav Med* 2006;29(4):377-87.
58. Stansfeld S, Shipley M, Marmot M. Work characteristics predict psychiatric disorders: prospective results from the Whitehall II study. *Occup Environ Med* 1999;56.
59. Stansfeld SA, Rael EGS, Head J, Shipley M, Marmot M. Social support and psychiatric sickness absence: a prospective study of British civil servants. *Psychological Medicine* 1997;27:35-48.
60. Kario K, McEwen BS, Pickering TG. Disasters and the heart: a review of the effects of earthquake-induced stress on cardiovascular disease. *Hypertens Res* 2003;26(5):355-67.
61. McEwen BS. From molecules to mind. Stress, individual differences, and the social environment. *Ann N Y Acad Sci* 2001;935:42-9.
62. Miller GE, Chen E, Zhou ES. If it goes up, must it come down? Chronic stress and the hypothalamic-pituitary-adrenocortical axis in humans. *Psychol Bull* 2007;133(1):25-45.
63. Taylor SE, Lerner JS, Sage RM, Lehman BJ, Seeman TE. Early environment, emotions, responses to stress, and health. *J Pers* 2004;72(6):1365-93.
64. Gruenewald TL, Seeman TE, Karlamangla AS, Sarkisian CA. Allostatic load and frailty in older adults. *J Am Geriatr Soc* 2009;57(9):1525-31.
65. Avendano M, Kunst AE, Huisman M, Lenthe FV, Bopp M, Regidor E, et al. Socioeconomic status and ischaemic heart disease mortality in 10 western European populations during the 1990s. *Heart* 2006;92(4):461-7.
66. Backlund E, Sorlie PD, Johnson NJ. A comparison of the relationships of education and income with mortality: the National Longitudinal Mortality Study. *Soc Sci Med* 1999;49(10):1373-84.
67. Hajat A, Kaufman JS, Rose KM, Siddiqi A, Thomas JC. Long-Term Effects of Wealth on Mortality and Self-rated Health Status. *Am J Epidemiol* 2010.
68. Kunst AE, Groenhouf F, Mackenbach JP. Mortality by occupational class among men 30-64 years in 11 European countries. EU Working Group on Socioeconomic Inequalities in Health. *Soc Sci Med* 1998;46(11):1459-76.





69. Steenland K, Hu S, Walker J. All-cause and cause-specific mortality by socioeconomic status among employed persons in 27 US states, 1984-1997. *Am J Public Health* 2004;94(6):1037-42.
70. Turrell G, Lynch JW, Leite C, Raghunathan T, Kaplan GA. Socioeconomic disadvantage in childhood and across the life course and all-cause mortality and physical function in adulthood: evidence from the Alameda County Study. *J Epidemiol Community Health* 2007;61(8):723-30.
71. Adler N, Singh-Manoux A, Schwartz J, Stewart J, Matthews K, Marmot MG. Social status and health: a comparison of British civil servants in Whitehall-II with European- and African-Americans in CARDIA. *Soc Sci Med* 2008;66(5):1034-45.
72. Chen E, Martin AD, Matthews KA. Socioeconomic status and health: do gradients differ within childhood and adolescence? *Soc Sci Med* 2006;62(9):2161-70.
73. Minkler M, Fuller-Thomson E, Guralnik JM. Gradient of disability across the socioeconomic spectrum in the United States. *N Engl J Med* 2006;355(7):695-703.
74. Newacheck PW, Hung YY, Park MJ, Brindis CD, Irwin CE, Jr. Disparities in adolescent health and health care: does socioeconomic status matter? *Health Serv Res* 2003;38(5):1235-52.
75. Winkleby MA, Cubbin C. Influence of individual and neighbourhood socioeconomic status on mortality among black, Mexican-American, and white women and men in the United States. *J Epidemiol Community Health* 2003;57(6):444-52.
76. Marmot MG, Bosma H, Hemingway H, Brunner E, Stansfeld S. Contribution of job control and other risk factors to social variations in coronary heart disease incidence. *Lancet* 1997;350(9073):235-9.
77. Smith PM, Frank JW, Mustard CA, Bondy SJ. Examining the relationships between job control and health status: a path analysis approach. *J Epidemiol Community Health* 2008;62(1):54-61.
78. Wege N, Dragano N, Erbel R, Jockel KH, Moebus S, Stang A, et al. When does work stress hurt? Testing the interaction with socioeconomic position in the Heinz Nixdorf Recall Study. *J Epidemiol Community Health* 2008;62(4):338-41.
79. Braveman P, Marchi K, Egerter S, Kim S, Metzler M, Stancil T, et al. Poverty, near-poverty, and hardship around the time of pregnancy. *Matern Child Health J* 2009;14(1):20-35.
80. Evans GW, English K. The environment of poverty: multiple stressor exposure, psychophysiological stress, and socioemotional adjustment. *Child Dev* 2002;73(4):1238-48.
81. Kahn JR, Pearlin LI. Financial strain over the life course and health among older adults. *J Health Soc Behav* 2006;47(1):17-31.
82. Lantz PM, House JS, Mero RP, Williams DR. Stress, life events, and socioeconomic disparities in health: results from the Americans' Changing Lives Study. *J Health Soc Behav* 2005;46(3):274-88.
83. Chen E, Hanson MD, Paterson LQ, Griffin MJ, Walker HA, Miller GE. Socioeconomic status and inflammatory processes in childhood asthma: the role of psychological stress. *J Allergy Clin Immunol* 2006;117(5):1014-20.
84. Hatch SL, Dohrenwend BP. Distribution of traumatic and other stressful life events by race/ethnicity, gender, SES and age: a review of the research. *Am J Community Psychol* 2007;40(3-4):313-32.
85. Matthews KA, Gallo LC, Taylor SE. Are psychosocial factors mediators of socioeconomic status and health connections? A progress report and blueprint for the future. *Ann N Y Acad Sci* 2010;1186:146-73.
86. Stronks K, van de Mheen H, Looman CW, Mackenbach JP. The importance of psychosocial stressors for socio-economic inequalities in perceived health. *Soc Sci Med* 1998;46(4-5):611-23.
87. Pearlin LI. The life course and the stress process: some conceptual comparisons. *J Gerontol B Psychol Sci Soc Sci* 2010;65B(2):207-15.
88. Braveman P, Egerter S, An J, Williams D. Issue Brief 5: Race and Socioeconomic Factors. Princeton, NJ: Robert Wood Johnson Foundation; 2009.
89. Williams DR. Race, socioeconomic status, and health. The added effects of racism and discrimination. *Ann N Y Acad Sci* 1999;896:173-88.
90. Williams DR, Mohammed SA. Discrimination and racial disparities in health: evidence and needed research. *J Behav Med* 2009;32(1):20-47.





91. Nuru-Jeter A, Dominguez TP, Hammond WP, Leu J, Skaff M, Egerter S, et al. 'It's The Skin You're In': African-American Women Talk About Their Experiences of Racism. An Exploratory Study to Develop Measures of Racism for Birth Outcome Studies. *Maternal and Child Health Journal* 2009;13(1):29-39.
92. Williams DR, Neighbors HW, Jackson JS. Racial/ethnic discrimination and health: findings from community studies. *Am J Public Health* 2003;93(2):200-8.
93. Geronimus AT, Hicken M, Keene D, Bound J. "Weathering" and age patterns of allostatic load scores among blacks and whites in the United States. *Am J Public Health* 2006;96(5):826-33.
94. Izzo CV, Eckenrode JJ, Smith EG, Henderson CR, Cole R, Kitzman H, et al. Reducing the impact of uncontrollable stressful life events through a program of nurse home visitation for new parents. *Prev Sci* 2005;6(4):269-74.
95. The National Medical-Legal Partnership. Impact. January 3, 2011]; Available from: <http://www.medical-legalpartnership.org/impact>
96. Health Leads. What is Health Leads? 2010 January 3, 2011]; Available from: <http://www.healthleadsusa.org/our-model/family-help-desk/>
97. Miller W, Simon P, Maleque S. Beyond health care: New directions to a healthier America. Washington, DC: Robert Wood Johnson Foundation Commission to Build a Healthier America; 2009.
98. Moen P, Kelly E, Chermack K. Learning from a national experiment: Studying a corporate work-time policy initiative. In: Crouter AC, Booth A, editors. *Work-life policies that make a real difference for individuals, families, and organizations*. Washington, DC: Urban Institute Press; 2007. Available from: <http://www.flexiblework.umn.edu>

