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## Does the Perception that Stress Affects Health Matter? The Association with Health and Mortality

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### Abstract

**Objective**—This study sought to examine the relationship among the amount of stress, the perception that stress affects health, and health and mortality outcomes in a nationally-representative sample of U.S. adults.

**Methods**—Data from the 1998 National Health Interview Survey were linked to prospective National Death Index mortality data through 2006. Separate logistic regression models were used to examine the factors associated with current health status and psychological distress. Cox proportional hazard models were used to determine the impact of perceiving that stress affects health on all-cause mortality. Each model specifically examined the interaction between the amount of stress and the perception that stress affects health, controlling for sociodemographic, health behavior, and access to healthcare factors.

**Results**—33.7% of nearly 186 million ( $n=28,753$ ) U.S. adults perceived that stress affected their health a lot or to some extent. Both higher levels of reported stress and the perception that stress affects health were independently associated with an increased likelihood of worse health and mental health outcomes. The amount of stress and the perception that stress affects health interacted such that those who reported a lot of stress and that stress impacted their health a lot had a 43% increased risk of premature death ( $HR = 1.43$ , 95% CI [1.20, 1.71]).

**Conclusions**—High amounts of stress and the perception that stress impacts health are each associated with poor health and mental health. Individuals who perceived that stress affects their health *and* reported a large amount of stress had an increased risk of premature death.

### Keywords

United States; Stress; Perception; National Health Interview Survey (NHIS); Mortality

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Stress, broadly defined as a situation “in which environmental demands, internal demands, or both, tax or exceed the adaptive resources of an individual, social system, or tissue system,” (Monat & Lazarus, 1991) is pervasive in today’s society, with nearly a third of Americans rating their average stress levels as extreme (8,9, or 10 on a 10-point scale where 10 corresponds to “a great deal of stress”) (APA, 2008). Consequences of prolonged stress include adverse psychological and physical health effects, as well as an increased risk of premature mortality (Braveman, Egerter, & Mockenhaupt, 2011; Lantz, House, Mero, & Williams, 2005; McEwen, 1998; McEwen & Seeman, 1999; Miller, Cohen, & Ritchey,

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2002). In fact, the effects of stress on well-being are so well recognized that U.S. public health officials have called for a reduction of stress since the 1970's (USPHS, 1979).

Previous research exploring the relationship between stress and health outcomes, including mortality, has focused on specific stressors – such as negative life events (Lantz et al., 2005) or chronic work stress (Matthews & Gump, 2002) – and is often limited to cause-specific mortality, such as cardiovascular disease (Burazeri, Goda, Sulo, Stefa, & Kark, 2008; Greenwood, Muir, Packham, & Madeley, 1996). While studies exploring the relationship between chronic or perceived stress and all-cause mortality exist (Krueger & Chang, 2008; Lantz et al., 2005), no study has examined the relationship between an individual's perception that stress affects their health and health outcomes.

The perception that stress affects one's health is conceptually distinct from the amount of stress an individual experiences; indeed, one could report experiencing very little stress but still believe it to have a great impact on their health. Additionally, the perception of stress affecting health may impact health outcomes differently than the amount or the severity of stress. Theoretical work supports the concept that the perception that stress affects one's health may impact future health outcomes. Notably, the transactional model of stress and coping provides critical insight into the appraisal of stress and the available resources for stress management (Lazarus & Folkman, 1984; Wenzel, Glanz, & Lerman, 2002).

According to the model, the impact of a stressor is mediated by a person's appraisal of the stressor. Primary appraisal is mainly determined by perceptions of susceptibility to the event as well as perceptions of the event's severity. Whereas appraisals of personal risk often lead to the initiation of coping mechanisms, a heightened perception of risk has been associated with increased psychological distress (Schwartz, Lerman, Miller, Daly, & Masny, 1995) and may be related to other adverse health outcomes. Based on this theoretical work, it is hypothesized that a heightened perception of the health risks associated with stress (as indicated by perceiving that stress impacts one's health) may be a key factor in determining or predicting future outcomes.

This is believed to be the first study to examine the relationship among the amount of stress individuals experience, whether or not they perceive that stress affects their health, and subsequent health and mortality outcomes in a nationally-representative sample of U.S. adults. This study aims to examine the relationship between the perception that stress affects health and current health, mental health, and mortality. Specifically, it is hypothesized that there will be a synergistic relationship between the amount of stress and an individual's perception that stress affects health, such that those with the highest amount of stress *and* the perception that it impacts their health will experience the worst health outcomes.

This study is unique in that it not only identifies individuals who report experiencing stress, but also those individuals who perceive that stress affects their health. Understanding this perception is critical for advancing knowledge of the health effects of stress and could have far reaching implications for future research and for designing interventions aimed at reducing the negative health consequences of stress.

## Methods

### Data Source & Study Design

The data originates from the 1998 National Health Interview Survey (NHIS), a household survey conducted by the National Center for Health Statistics (NCHS) (NCHS, 2000). The NHIS oversampled underrepresented populations, including Hispanics and African Americans, and used a multistage stratified probability design to yield nationally representative estimates. The 1998 NHIS was used for this study due to its specific questions

on perceived stress, stress management, and perceived impact of stress on health. It appears that such data do not exist in other recent surveys. All results are based on weighted counts.

**Study sample**—To obtain the sample, participants were selected from the Sample Adult Core (SAC) component of the NHIS and linked to the Prevention Adult component of the Prevention Module, a supplemental questionnaire on prevention for selected topics of interest to the public health community (NHIS, 1998). Participants with missing values on covariates or outcome measures were not included in the study sample (6.7%). Additionally, sample records that could not be linked to the National Death Index (NDI) as a result of missing information on matching characteristics (4.5%) were eliminated from the study sample, yielding a final sample of 28,753 respondents, of whom 2,960 (10.3%) had died.

## Measures

### Stress measures

**Amount of Stress:** To determine the amount of stress experienced in the last 12 months, respondents were asked, “During the past 12 months, would you say that you experienced a lot of stress, a moderate amount of stress, relatively little stress, or almost no stress at all?” This variable was modeled using the original Likert format.

**Perception of stress affecting health:** To determine the perceived impact of stress on health respondents were asked, “During the past 12 months, how much effect has stress had on your health – a lot, some, hardly any, or none?” This variable was modeled using the original 3-point Likert format.

**Stress reduction:** To ascertain whether or not individuals had attempted to reduce their amount of stress, participants were asked, “During the past 12 months, have you taken any steps to control or reduce stress in your life?” Responses to this question were modeled using a dichotomous (i.e. yes/no) format.

### Outcomes

**Health status:** Health status was assessed through self-report by asking respondents to rate their health as: excellent, very good, good, fair, or poor. Adichotomous variable was used in the analyses, comparing those in excellent, very good, or good self-reported health to those in fair or poor self-reported health (hereafter referred to as “poor health”) (Zahran et al., 2005).

**Psychological distress:** Current psychological distress was measured using the Kessler Psychological Distress Scales, included in the Sample Adult Core component of the NHIS. The K6, a truncated form of a previously developed 10-question psychological distress scale (K10) asks participants to report the frequency of six emotions (i.e. feeling nervous, hopeless, fidgety, depressed to the extent that nothing could cheer them up, worthless, and that everything was an effort) over the past 30 days (Furukawa, Kessler, Slade, & Andrews, 2003). The K6 has been shown to have a strong, positive correlation with DSM-IV diagnoses (Kessler et al., 2003) and common mental disorders (Gill, Butterworth, Rodgers, & Mackinnon, 2007). It has also been found to have highly acceptable psychometric properties as demonstrated by an internal consistency, measured by Cronbach’s  $\alpha$ , of 0.89 and discrimination, evaluated by assessing the area under the Receiver Operating Characteristic (ROC) curve, of 0.86 (Kessler et al., 2003).

Each of the six items in the K6 were coded on a 5-point scale (none of the time, a little of the time, some of the time, most of the time, or all of the time). The response codes were then summed for a potential total score range of 0–24, with higher scores indicating worse

levels of psychological distress. A score of 7 or more was used to indicate mild-moderate psychological distress. Psychological distress has been operationalized in a similar fashion in previous studies (Witt et al., 2006; Witt et al., 2009) and is consistent with norm-based scoring developed for the K6 in community and epidemiological samples and classification of scores developed and normalized in the 1997 NHIS (Kessler et al., 2002).

**Mortality:** Mortality was measured as death from any cause between the respondents 1998 interview quarter and December 31, 2006. Information on deaths among participants was obtained from the NDI. Data from the 1998 NHIS were linked to prospective NDI mortality data by the NCHS. The matching methodology included matching respondent characteristics (Social Security number; first and last name; middle initial; race; gender; marital status; father's surname; day, month, and year of birth; state of birth and residence) to death records (NCHS, 2009). The NHIS public-use ID was then used to link respondents in the Prevention Adult component of the Prevention Module to mortality information in the NDI public-use files.

### **Independent variables**

**Sociodemographic characteristics:** The following demographic characteristics were included in the analyses due to their known relationships with the outcomes of interest: gender, race/ethnicity (Hispanic, white [non-Hispanic], black [non-Hispanic], and other [non-Hispanic]), age (17–24, 25–34, 35–44, 45–54, 55–64, and 65+), level of education (some high school or less, high school graduate, some college, college graduate or beyond, and unknown), participation in the paid workforce (had job in the past week, had no job in the past week but had a job in the past 12 months, and had no job in the past week or in the past 12 months), marital status (married or living with partner, widowed, divorced/separated, never married, and unknown), urbanicity (urban versus rural as defined by metropolitan statistical area status), and household income, as a percentage of the poverty threshold level (below 100%, 100–199%, 200–399%, 400% and higher, and unknown). A sensitivity analysis was performed disaggregating the number of children in the household to reflect different family sizes. No significant trend was found; therefore, a dichotomous variable of “no children” or “1+ child(ren)” was used in the analysis.

**Health and health behavior factors:** Respondents were classified as having a chronic condition if they reported having ever been told by a doctor or other health professional that they had one or more of a number of chronic conditions, including hypertension, coronary heart disease, angina, heart attack, any other heart condition or heart disease, stroke, cancer, ulcer, asthma, emphysema, or diabetes.

For smoking, participants were categorized as “never smokers” (had not smoked more than 100 cigarettes in their life), “current smokers” (smoked more than 100 cigarettes in their life and currently smoked some days or every day), or “former smokers” (smoked more than 100 cigarettes in their life but reported that they now smoke not at all).

To determine physical activity level, respondents were questioned about 23 physical activities and asked to provide information regarding the frequency of these activities, the number of minutes spent doing the activity, and the change in their heart rate or breathing as a result of the activity. A summary measure indicating activity level for each participant in terms of kilocalories per kilogram of body weight (kcal/kg/day) was calculated using an algorithm based on published work by Stephens and Craig (1989) as well as the 1981 Canada Fitness Survey (Stephens & Craig, 1989). Individuals expending 3.0 or more kcal/kg/day were classified as “very active,” those expending 1.5–2.9 kcal/kg/day as “moderately active,” and those expending 0.0–1.4 kcal/kg/day as “sedentary” (NHIS, 1998).

### Access to healthcare factors

**Health insurance:** Respondents who had health insurance coverage from any source were considered to be insured. Those who reported not having any health insurance were categorized as being uninsured.

**Usual source of care:** To ascertain if they had an appropriate usual source of care (USC), respondents were asked the following questions, “Is there a place that you usually go to when you are sick or need advice about your health?” and if yes, “What kind of place is it – a clinic, doctor’s office, emergency room, or some other place?” Individuals who responded that they did not have a USC, or reported the emergency room as their USC, were classified as not having a USC.

### Analytic Approach

Analyses presented in Tables 1 and 2 were generated using SUDAAN (RTI, 2001) to correct for the complex sample design of the NHIS. Separate multivariate logistic regression models examined the factors associated with current health status and psychological distress. These models specifically examined the interaction between an individual’s amount of stress and their perception that stress affected their health, controlling for sociodemographic, health behavior, access to healthcare factors, and attempts at stress reduction.

Cox proportional hazard models were used to examine the impact of the amount of stress experienced and perceiving that stress affects health on all-cause mortality, controlling for sociodemographic, health behavior, and access to healthcare factors, as well as attempts at stress reduction. Time of death due to any cause, determined using the quarter and year of death from NDI data, was used as the end point. Individuals who were still living (hence not matched to NDI data) were right-censored using the date of December 31, 2006. The start time for all individuals was the beginning of the quarter in which they were interviewed for the 1998 NHIS. Post-estimation statistics used to test the proportional hazards assumption found no significant violations of the assumptions of the model. Stata/SE 11.0 for Windows (StataCorp, 2009) was used to perform all mortality analyses. The Wald and the Likelihood Ratio Chi-Squared Tests (LRT) were used to test the significance of the interaction between the amount of stress experienced and the perception that stress affects health and the health outcomes.

The “predict” command in Stata/SE 11.0 (StataCorp, 2009) was used to estimate cumulative hazards from the Cox proportional hazard model for each of the 12 subgroups created from the interaction of the amount of stress and the perception that stress affects health, averaged across all other covariates. The hazards were applied to the weighted number of individuals who reported a lot of stress and the perception that stress affects health a lot, and the difference was taken to determine the number of deaths attributable to endorsing both of these factors during the study period.

The full tables for the current health status, psychological distress, and all-cause mortality outcomes are also available as supplementary materials (Appendix A and B).

**Additional analysis included in appendices**—In addition to the above analyses, chi-squared analyses and regression models were conducted to examine the frequency distributions and the odds of the amount of stress and perceiving that stress affects health (Appendix C and D). Chi-squared analyses were used to test for differences in sociodemographic characteristics of adults and the amount of stress experienced. Sociodemographic, health behavior, and access to healthcare factors were examined in multinomial multivariate logistic regression models for the amount of stress experienced

(Appendix A). The same approach was used to examine the outcome of perceiving that stress affects health (Appendix B).

## Results

Overall, 35.3% and 20.2% of this sample of U.S. adults reported experiencing a moderate amount or a lot of stress in the past year, respectively, and 32.9% had taken steps to control or reduce stress in their lives (Table 1). Additionally, 7.8% and 25.9% of this sample perceived that stress had affected their health a lot or to some extent during the same time period, respectively.

### Stress and Health Outcomes

Table 2 presents the results of the separate logistic regression models examining the factors associated with current health status and psychological distress. These models tested the interaction between an individual's amount of stress and their perception that stress affected their health, controlling for sociodemographic, health behavior, access to healthcare factors, and attempts at stress reduction; however, statistical testing for the presence of an interaction using the LRT was not significant for either outcome. As such, Table 2 presents the results from the main effects models.

**Current health status**—As seen in Table 2, the analysis of current health status revealed that higher levels of reported stress were associated with an increased likelihood of reporting poor health. Specifically, adults who reported a little or a moderate amount of stress were more likely to report being in poor health (odds ratio [OR] = 1.16, 95% confidence interval [CI] [1.0, 1.4] and OR = 1.36, 95% CI [1.2, 1.6], respectively) compared to those who reported experiencing almost no stress in the last 12 months. Additionally, reporting the perception that stress affects health was also associated with an increased likelihood of reporting poor health. Compared to those who reported hardly any or no perceptions of stress affecting health, those who reported perceiving that stress affected health “some” or “a lot” were about two times (OR = 1.80, 95% CI [1.6, 2.1]) and four times (OR = 4.26, 95% CI [3.6, 5.1]) more likely to report being in poor health, respectively. Adults who reported taking attempts to reduce their stress in the last 12 months were less likely to report being in poor health (OR = 0.92, 95% CI [0.82, 1.03]).

**Psychological distress**—The analysis of psychological distress revealed that adults who reported higher levels of stress were also more likely to report being in psychological distress. Compared to those reporting almost no stress in the last 12 months, those who reported a little stress, a moderate amount of stress, or a lot of stress were more likely to report being in psychological distress (OR = 1.81, 95% CI [1.5, 2.2]; OR = 2.86, 95% CI [2.3, 3.5]; and OR = 7.35, 95% CI [6.0, 9.1], respectively). Moreover, reporting the perception that stress affects health was associated with an increased likelihood of reporting psychological distress. Specifically, those who reported perceiving that stress had affected their health “some” or “a lot” were over two times (OR = 2.55, 95% CI [2.2, 2.9]) and five times (OR = 5.10, 95% CI [4.3, 6.0]) more likely to report being in psychological distress, as compared to those who reported hardly any or no perception that stress affected their health. Adults who reported taking attempts to reduce their stress in the last 12 months were no less likely to report psychological distress than their counterparts who did not take any steps to reduce their stress (OR = 1.07, 95% CI [0.96, 1.20]).

**Premature mortality**—Table 3 reports results from the proportional hazard model estimating the risk of death among this sample of U.S. adults. Neither the amount of stress nor the perception that stress affects health independently predicted premature mortality.

However, the interaction between the amount of stress reported and the perception that stress affects health was statistically significant (using the Wald test [ $p < 0.05$ ]) such that reporting a lot of stress *and* perceiving that stress affects health a lot increased the risk of death by 43% (Hazard Ratio [HR] = 1.43, 95% CI [1.2, 1.7]). This represents an increase in the predicted cumulative hazard of death due to the stress interaction from 3.5% to 5.1% for those who reported a lot of stress in the past 12 months *and* the perception that stress affects health a lot compared to those who did not report either. Using these cumulative hazards at the end of the study follow-up period under the assumption of causality, it was estimated that the excess deaths attributable to this combination of stress measures over the study period was 182,079 (controlling for all other covariates), or about 20,231 deaths per year (over 9 years).

### Sensitivity Analysis

Given the strong relationship between stress and health and the well-established relationship between self-reported health and mortality, we examined the potential mediating role of self-reported health on stress and mortality. Analyses revealed that the inclusion of self-reported health mediated the relationship between the stress interaction term and mortality such that the highest interaction category (reported experiencing a lot of stress *and* perceiving that stress impacts their health a lot) was attenuated from HR of 1.43 to HR of 1.18 and was of borderline significance ( $p = 0.076$ ).

### Discussion

This study indicates that individuals reporting both a high amount of stress and the perception that stress affects their health may be at a greater risk of premature mortality, over and above those who report high stress or perceived health effects of stress alone. These findings have significant implications for theories of stress and health. The hypotheses and results support the notion that stress appraisal is critical in determining outcomes (Lazarus & Folkman, 1984). This study provides a key contribution to the theoretical literature by building on this notion, in testing whether or not the perception that stress affects one's health is associated with adverse health outcomes. The results suggest that the appraisal of both the amount of stress *and* its impact on health may work together synergistically to increase the risk of premature death. These findings provide new insights into the pathways by which stress may impact health outcomes and suggest new ways of understanding the linkages among stress, coping, and health.

In this study, the perception that stress affects health was found to act synergistically with amount of stress to predict an increased risk of premature death. Specifically, reporting a lot of stress *and* perceiving that stress affected one's health a lot increased the risk of premature death by 43%. To capture the potential clinical and public health significance of this finding, the cumulative hazards models were used to estimate the number of excess deaths attributable to this combination of stress measures. If this were in fact a causal relationship, 20,231 deaths each year would be attributable to having a lot of stress and perceiving that stress affects health a lot. Based on the 2006 Centers for Disease Control and Prevention (CDC) rankings, this would coincide with the number of deaths attributable to essential hypertension and hypertensive renal disease (the 13<sup>th</sup> leading cause of death in the U.S) and Parkinson's disease (the 14<sup>th</sup> leading cause of death) (CDC, 2011). While this study is unable to establish a causal relationship, these results highlight the necessity for further research into the relationship between the perception that stress affects health and current health, mental health, and mortality.

Possible explanations for the synergistic effect seen between the amount of stress and the perceived impact of stress on health include a person's negative expectancies, resiliency,

and locus of control regarding health. An individual's perception of health plays an important role in determining health outcomes. Studies have shown that having negative (i.e. pessimistic) expectations of life events is predictive of poor physical and mental health and increased use of the health care system (Geers, Kosbab, Helfer, Weiland, & Wellman, 2007; Maruta, Colligan, Malinchoc, & Offord, 2002). Furthermore, individuals with negative expectations are even more likely to exhibit negative health symptoms, even when given placebo treatments (Geers et al., 2007). In light of this finding, a possible explanation of the results could be that the perception that stress affects one's health is a proxy for negative expectations; therefore, those with this perception will subsequently report their health as poor (i.e. self-fulfilling prophecy).

Resiliency is an important and often overlooked resource for coping with stress. Individuals who have experienced a moderate amount of adversity in the past exhibit more resilience to recent adversity (Seery, Holman, & Silver, 2010), suggesting that previous experiences with stress may help individuals cope with current stress. Resilient individuals, therefore, may not perceive that stress affects their health or experience negative health outcomes even when faced with a lot of stress. Research is needed to evaluate the relationship between resiliency and the perception that stress impacts one's health in order to further determine if resiliency-development interventions could improve health outcomes among those with high stress.

An individual's health locus of control, defined as their beliefs in the control they have over their own health (Wallston, Stein, & Smith, 1994), may also contribute to a heightened perception of the health implications of stress. Those who perceive that stress affects their health may have an external locus of control, believing that their health is not in their control, but attributable to external circumstances. Studies have indicated that individuals who have a high external locus of control experience worse outcomes than those who feel that their health is within their control (Heath, Saliba, Mahmassani, Major, & Khoury, 2008; Preau et al., 2005). Although much of this research has focused on those with an illness, the present study suggests that health-related locus of control (as seen in a greater perceived impact of stress on health) may also contribute to outcomes in healthy populations. As such, encouraging active attempts at problem solving and increasing an individual's sense of control over their stress levels and health may potentially lead to better health outcomes by allowing individuals to better utilize coping resources (Thoits, 1995).

In addition, reverse causality may partially explain the findings in this study. Adults who reported poor health may have been more likely to report that stress impacts their health simply due to their poor health status; moreover poor health status could also have influenced the amount of stress reported. The cross-sectional nature of these data precludes us from examining the direction of causality among the amount of stress, the perception that stress affects health, and health outcomes.

While this study is unable to investigate the biological processes responsible for the findings in this study, allostasis – the process of achieving homeostasis through adjustments to the biological system in response to stress (McEwen, 1998) – may be one potential mechanism. Although protective in the short term, increased levels of hormonal mediators associated with the human stress response can be deleterious to the individual if repeated or prolonged (Lantz et al., 2005; McEwen & Seeman, 1999). Moreover, increased allostatic load has been associated with worse physical and cognitive function and an increased risk of mortality (Seeman, McEwen, Rowe, & Singer, 2001). Individuals who report a lot of stress and the perception that stress affects their health may be experiencing the negative health consequences of increased allostatic load, where the individual's stress response system has been taxed to the point of inciting negative physiological and psychological responses.



Although this study did not find any significant relationship between attempts at reducing the amount of stress and the psychological distress and mortality outcomes, it did find that the association between attempting to reduce the amount of stress experienced and the likelihood of reporting being in poor physical health to be of borderline significance. The lack of significant evidence of a clear relationship between attempts at stress reduction and health outcomes could be due to selection issues, as it is possible that adults who attempt to reduce the amount of stress they experience may be different than those who do not. Further experimental research is needed to understand the relationship between attempts at stress reduction and health outcomes.

The findings in this study may have important implications for shaping future research aimed at furthering the understanding of the effects of stress on health. Future work may benefit from incorporating measurements of the perceived impact of stress on health in addition to measures of specific stressors and perceived stress. While the role, if any, of these findings in health improvement interventions focusing on overall stress reduction is unclear, the study findings indicate that this area merits future exploration.

This study has several limitations. First, all data used for these analyses except mortality were cross-sectional and thus limited the ability to assess the temporality of stress and health outcomes. However, despite the fact that the questions ascertaining the amount of stress and the perceived effects of stress on health were asked at the same time as those used to operationalize health and mental health status, the reference time period differed. The stress measures referred to the past 12 months, the mental health status questions to the past 30 days, and the health status question to the respondent's health at the time of the interview. To account for the possibility that prior health status may have influenced individuals' perceptions of how stress affected their health, a flag for chronic conditions was included in the model. This did not appear to change the findings for the physical or mental health outcomes; however, this measure may not have adequately captured prior health status. Second, the cross-sectional nature of the data limits the ability to explore possible mechanisms for the findings of the study related to: 1) the health and psychological distress outcomes and 2) the potential mediating role of self-rated health on stress and mortality. The available data also limits the ability to fully determine the independent nature of the stress variables used in the analysis. However, this study demonstrates that the perceived impact of stress on health deserves further exploration. Future research will need to explore these relationships over time. Third, information about the amount of stress and the perception that stress affects health was obtained through self-report using a sole reporter. This may have resulted in misclassification of some respondents. In addition, the health behavior measures used, particularly physical activity level, are based on self-report and may be prone to errors in reporting, as research indicates that respondents typically over-report their physical activity level (Duncan, Sydean, Perri, Limacher, & Martin, 2001; Troiano et al., 2008). Finally, this study was unable to address the role of factors that may be associated with perceptions of stress and health outcomes such as personality (e.g. neuroticism).

This study has important strengths. First, the results are based on national, population-based data, providing insight into the individual and family-level sociodemographic, health-behavior, and healthcare factors associated with the perception of stress affecting the health of U.S. adults. Due to the large sample size of the NHIS, several key predictors of perceiving that stress affects one's health could be examined together in one model, allowing for adjusted estimates of the contributing effect of each characteristic. Additionally, the study incorporated a large number of deaths over a 9-year follow-up period.

This study extends previous research on the relationship between stress and health by examining the perception of stress affecting health in a nationally representative population-based sample of adults. The findings show that individuals who reported the perception that stress affected their health *and* reported a large amount of stress have an increased risk of premature death. Further research focused on the relationships between the perception of stress affecting health and morbidity and mortality outcomes will be essential to understanding the health effects of stress.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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**Table 1**

Frequency of Stress, Perceived Health Impact, and Stress Reduction among U.S. Adults, 1998 NHIS

	<b>TOTAL: Weighted N [in thousands] (unweighted N) %</b>
	185,983 (28,753) 100%
<b>Frequency of Stress</b>	
Amount of stress experienced by U.S. adults in the last 12 months	
A lot	37,628 (6,026) 20.2%
Moderate	65,627 (9,663) 35.3%
Relatively little	44,642 (6,871) 24.0%
Almost none	38,087 (6,193) 20.5%
<b>Perceived Health Impact</b>	
How much did stress affect your health?	
A lot	14,500 (2,468) 7.8%
Some	48,176 (7,522) 25.9%
Hardly any, or none	123,306 (18,763) 66.3%
<b>Stress Reduction</b>	
(During the past 12 months), have you taken any steps to control or reduce stress in your life?	
Yes	61,193 (9,489) 32.9%
No	124,790 (19,264) 67.1%

Logistic Regression Analysis of Current Health and Mental Health among U.S. Adults Experiencing Stress and the Perception that Stress Affects Health, 1998 NHIS

**Table 2**

	Poor Health Status		Psychological Distress	
	OR	95% CI	OR	95% CI
<b>Amount of Stress in last 12 months</b>				
Almost None	1.00	reference	1.00	reference
A Little	1.16	1.0 1.4	1.81	1.5 2.2
Moderate	1.36	1.2 1.6	2.86	2.3 3.5
A lot	1.75	1.5 2.1	7.35	6.0 9.1
<b>Perception that Stress Affects Health</b>				
Hardly any, or None	1.00	reference	1.00	reference
Some	1.80	1.6 2.1	2.55	2.2 2.9
A lot	4.26	3.6 5.1	5.10	4.3 6.0
<b>Tried to Reduce Stress in last 12 months</b>				
Yes	0.92 <sup>†</sup>	0.8 1.0	1.07 <sup>§</sup>	1.0 1.2
No	1.00	reference	1.00	reference

Controlling for gender, race/ethnicity, age, education level, work status, marital status, children in the household, ratio of family income to poverty threshold, metropolitan statistical area, smoking status, physical activity level, chronic condition, health insurance, usual source of care, and whether the individual took measures to reduce stress

OR= odds ratio; CI=confidence interval

Note: Interpretation of significance at the 95% level was based on CI limits before rounding.

MSA=Metropolitan Statistical Area

<sup>†</sup> Borderline significance, OR=0.92, 95% CI [0.82–1.03]

<sup>§</sup> Not statistically significant, OR=1.07, 95% CI [0.96–1.20]

**Table 3**

Cox Proportional Hazards for All-Cause Mortality among U.S. Adults Experiencing Stress and the Perception that Stress Affects Health

	<u>All-Cause Mortality</u>		
	<u>HR</u>	<u>95% CI</u>	
<b>Almost no stress in last 12 months</b>			
Hardly any, or No perception that stress affects health	1.00	reference	
Some perception that stress affects health	0.96	0.6	1.5
Perception that stress affects health a lot	1.04	0.3	3.7
<b>Little stress in last 12 months</b>			
Hardly any, or No perception that stress affects health	1.00	0.9	1.1
Some perception that stress affects health	0.90	0.7	1.1
Perception that stress affects health a lot	1.10	0.3	3.5
<b>Moderate stress in last 12 months</b>			
Hardly any, or No perception that stress affects health	1.00	0.9	1.1
Some perception that stress affects health	1.15	1.0	1.3
Perception that stress affects health a lot	0.85	0.6	1.2
<b>A lot of stress in last 12 months</b>			
Hardly any, or No perception that stress affects health	0.83	0.6	1.1
Some perception that stress affects health	0.91	0.7	1.1
Perception that stress affects health a lot	1.43	1.2	1.7

Controlling for gender, race/ethnicity, age, education level, work status, marital status, children in the household, ratio of family income to poverty threshold, metropolitan statistical area, smoking status, physical activity level, chronic condition, health insurance, usual source of care, and whether the individual took measures to reduce stress

*Note:* Interpretation of significance at the 95% level was based on CI limits before rounding.

MSA=Metropolitan Statistical Area

HR= hazard ratio; CI=confidence interval

The Wald test for the interaction significant ( $p < .05$ )