Published in final edited form as:

Psychosom Med. 2017 May ; 79(4): 416–425. doi:10.1097/PSY.0000000000000412.

The Role of Agonistic Striving in the Association between Cortisol and High Blood Pressure

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Abstract

Objectives—A social action theory of chronic stress proposes that agonistic striving (seeking to influence or control others) impairs cardiovascular health by magnifying the impact of high adversity-induced cortisol levels on blood pressure. We tested three predictions of social action theory: (1) the social action theory taxonomy of regulatory strivings characterizes young adults from high-adversity neighborhoods; (2) high cortisol levels predict high blood pressure more reliably in the subgroup with the agonistic striving profile than in subgroups with other profiles; (2) the association of higher cortisol and higher blood pressure with agonistic striving is not explained by negative affect (depressive symptoms/dysphoria, anger, hostility).

Methods—Participants were young adults ($n = 198$, mean [standard deviation] age = 32 [3.4] years); 71% female; 65% Black) from disadvantaged urban neighborhoods. Motive profiles (including agonistic strivings) were assessed using the Social Competence Interview. Cortisol levels were derived from saliva samples; blood pressure level was obtained during two days of ambulatory monitoring. Psychological measures of negative affect were assessed using questionnaires.

Results—The predicted taxonomy of regulatory strivings was replicated in this sample; the interaction between cortisol and motive profile was significant ($F(2, 91) = 6.72, p = .002$); analyses of simple effects disclosed that higher cortisol levels predicted higher ambulatory blood pressure only in individuals who exhibited agonistic striving. Depressive symptoms/dysphoria, trait anger, and hostility were not correlated with agonistic striving, cortisol, or blood pressure.

Conclusions—Agonistic striving may represent a distinctive (and novel) social-cognitive mechanism of toxic stress and cardiovascular risk.

Keywords

cortisol; agonistic striving; implicit goals; depression; anger; hostility; hypertension

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Conflicts of Interest: All authors declare that there are no conflicts of interest.

Introduction

Evidence linking heart disease and stroke risk to race and social status points to harsh life circumstances as potential health threats (1). But how can our surroundings and the reactions they evoke cause serious illness? We approach this question within the framework of the social action theory of chronic stress (2, 3), which holds that toxic environments can lead us to blindly pursue goals that are self-protective yet stress-inducing—goals that make one overly controlling of others, irritable, and demanding. Struggling to manage one's interpersonal world grows emotionally exhausting, and fosters ongoing power struggles that damage health by generating hypervigilant states that dysregulate neuroendocrine and autonomic systems. Chronic stress, in this view, is largely a product of two factors: goals that increase stress *exposure*, and regulatory processes that modulate stress *responding*. Research evidence supports the social action theory model in predicting risk for hypertension, chronic pain, and somatic illnesses (3–6), as well as earlier relapse following treatment of alcohol-use disorders (7), and indicates that goal-based stress may mediate the association between adverse neighborhood environments and illness (8). We now extend this model to the challenge of explaining how stress-induced autonomic dysregulation (indexed by elevated cortisol levels) increases cardiovascular risk (indexed by high ambulatory blood pressure) in young urban adults who grew up in disadvantaged neighborhoods (9).

The ecological-transactional model of self-regulation advanced by social action theory holds that we shape our environments and ourselves through self-directive activities that let us act upon the social world to obtain resources while we modulate the internal impact of self-world encounters. Self-direction is enabled by cognitive problem-solving activities that generate action goals, or cognitive representations of desired events (2, 10). Response modulation, which is enabled by cognitive-affective mechanisms of attention and appraisal (11) linked to processes of autonomic control (e.g., (12), operates in concert with and supports self-directive problem solving. Conditions or events that repeatedly disrupt self-direction and response modulation can generate ongoing struggles to regulate self or world. Such struggles gradually form self-organizing patterns, or *motive profiles*, that are defined either by a persistent effort to change the self or to change other people. Different profiles have different effects on health and well-being.

Social action theory proposes further that self-directive problem solving operates at different levels of consciousness (13). Thus, goals that guide and impel action in stressful situations often are nonconscious or implicit, and can be hard to identify with self-reports (14). Instead, a person's implicit strivings may be observed and reliably measured with a stress-focused problem-solving exercise such as that afforded by the Social Competence Interview (SCI; (15). Implicit goals revealed with the SCI and explicit goals obtained by self-report may yield different predictions of health outcomes; indices of physiologic dysregulation (e.g., cortisol, blood pressure) are expected to correlate more closely with implicit goals (2, 16, 17).

Guiding Hypotheses

Social action theory advances three novel hypotheses that frame the present study.

A taxonomy of regulatory strivings—Research with the SCI has yielded a natural taxonomy of self-organizing regulatory strivings: (a) *agonistic striving*, or struggling to change others but not oneself; (b) *transcendence striving*, or struggling to change oneself but not others; and (c) *dissipated striving*, or lack of goal focus (e.g., wishing that the recurring problem would magically disappear). Agonistic striving is most likely to foster chronic arousal because it yields continuing interpersonal contests whose outcomes are hard to predict or control (3, 5–7).

Agonistic goals interact with response modulation deficits—A second hypothesis is that implicit agonistic goals and response modulation processes represent separate regulatory mechanisms that interact to influence stress exposure and health. Risk is greatest in persons with the agonistic striving profile who also exhibit impaired response modulation (3) (5) (7) (16).

Agonistic goals influence physiology independently of emotions—Social action theory holds that goals differ qualitatively from emotions, attitudes, and beliefs (16, 18). This suggests the hypothesis that agonistic strivings can shape health outcomes independently of affective dispositions, emotional responses to social-evaluative threats, or hostile beliefs and attitudes. A goal may cause one to suffer intense psychobiological self-regulatory stress even when one is not aware of feeling socially threatened, anxious, sad, or angry (3, 5, 7, 16).

The Present Study

This study tested the hypothesis that implicit agonistic motives interact with autonomic regulatory dysfunction to increase the risk for hypertension in young adults from distressed urban neighborhoods. Our approach is guided by a model of stress-induced allostatic accommodation and *allostatic load* (i.e., stress-induced long-term wear and tear on physiologic systems) that contributes to cardiovascular and immune-related illnesses (19). Cortisol is a principal neurohormonal mediator of allostatic accommodation (20); increased cortisol production due to centrally induced hypothalamic-pituitary-adrenal axis (HPA) activation is associated with high blood pressure, which is a primary indicator of increased allostatic load (21). Chronic exposure to adverse circumstances increases levels of central and peripheral cortisol, thus fostering cardiovascular changes that lead to hypertension and heart disease (22). Prolonged dysregulation of cortisol, combined with other stress hormones (e.g., catecholamines), may impair the endothelium's ability to generate vasodilating factors (nitrous oxide in particular), thus fostering high blood pressure linked to persistent impaired vasodilation, vascular remodeling, and vascular stiffness (23, 24). Glucocorticoids also can adversely affect vascular tone by enhancing contractile reactivity to norepinephrine (25), another possible contributor to high blood pressure. We propose that hypervigilant states associated with agonistic striving facilitate the combined action of these neurohormonal and vascular mechanisms to increase blood pressure levels. Thus, agonistic striving magnifies the impact of allostatic load (indexed by cortisol) on blood pressure.

Although agonistic striving is our focus, we also consider that other psychosocial processes may interact with cortisol to raise blood pressure. Depression, a clinical syndrome marked

by persistent feelings of sadness, loss of motivation, anhedonia, passivity, and social withdrawal, has been associated with changes in brain regions that enable executive functions (e.g., goal formation, planning, action, evaluation) that are needed to prevent or remove stressors (26). Also, difficulties in self-regulating angry emotions, often reflected in chronic hostility, may increase arousal in social encounters and contribute to ongoing psychological distress (27).

We evaluated these hypotheses by testing three predictions. First, the social action theory taxonomy of regulatory strivings (motive profiles) observed in previous research will be replicated in a sample of young urban adults, most of whom are African Americans who grew up in disadvantaged city neighborhoods described in an earlier report (9). Second, higher blood pressure levels in this group will be associated with chronically higher levels of peripheral cortisol; this relationship will be magnified in persons who exhibit the agonistic striving profile. Third, the association of agonistic striving and cortisol with blood pressure will not be explained by negative affect indexed by depressive symptoms/dysphoria, trait anger-proneness, or hostility. Diastolic pressure was the primary dependent variable due to its sensitivity to vigilance-induced changes in peripheral resistance associated with increased vasoconstriction (28), and because large diastolic changes induced by threat appraisals mark the hemodynamic signature of the SCI (29).

Method

Participants

Participants were part of Project Heart 6 (PH6), a follow-up study of young adults who earlier had participated in one of three Project Heart studies of psychosocial influences on cardiovascular disease risk in low-income urban youth. Conducted in Baltimore, Maryland, between 1987 and 1999, Project Heart studies 1, 2, and 3 (PH1-3) included risk assessment, observational, and experimental studies in two public magnet high schools that drew students from all neighborhoods of Baltimore City. PH6, conducted from 2006 to 2011, traced the original PH1-3 participants (N=565) to invite them to take part in follow-up research. Extensive tracing by the Battelle Institute, of St. Louis, Missouri, succeeded in locating and contacting 386 (68%) of former PH1-3 participants; of this group, 215 participated in PH6 and 99 of these provided the data reported here. The age of PH6 participants when they participated in the original PH1-3 studies was [M; standard deviation {SD}] = 14.4 [0.5] years; when they entered PH6, their ages ranged from 26 to 38 years. The racial demographics of the PH6 sample (65% Black, 35% White) closely matched the original PH1-3 samples, which matched the racial composition of the city of Baltimore in the early 1990's (9). Comparisons of former PH1-3 participants who later entered PH6 with former PH1-3 participants who did not disclosed that, relative to the latter, those entering PH6 had significantly higher BMI as adolescents (M [SD] = 24.5 [5.9] vs. 23.4 [5.3]; $t(563) = -2.10$, $p = .036$) and a higher percentage were female (73% vs 62%, $p = .011$). The two groups' levels of systolic and diastolic blood pressure in adolescence did not differ, however ($p = .36$ and $.65$, respectively). The relatively higher proportion of females in PH6 partly reflected the fact one of the two participating schools in PH1-3 was an all-female public high school. Of the 99 individuals who participated in the present study, 75% were female,

69% Black, and 30% White; their mean age was 32 (3.4) years. Most (70%) reported an annual household income above \$75,000; 48% had received education beyond high school. In recognition of the time and effort that data collection entailed, all received \$300.

Procedure

All informed consent and assessment procedures were approved in advance by the IRBs of Syracuse University and Johns Hopkins University. Data were collected during two clinic visits to the Johns Hopkins Bloomberg School of Public Health. Visit 1 included assessment of anthropometric characteristics, motive profiles, and negative affect (depressive symptoms/dysphoria, anger, hostility); participants' ambulatory blood pressure then was recorded in their normal environment during a 24-hour weekday. A second clinic visit about two weeks after the first was scheduled in the morning within three hours of the participant's normal waking time to facilitate a fasting blood draw (not reported here). Participants provided saliva cortisol samples and took part in new interview protocols (the latter are not part of this report). A second 24-hour ambulatory blood pressure assessment, identical to the first, immediately followed this visit.

Cortisol

During the second clinic visit, cortisol was assessed with 3 saliva samples obtained over a 90 minute interval. Saliva was sampled with Salivette[®] swabs and stored below -20°C for processing by immunoassay (Salimetrics[®]) at the General Clinical Research Center of the Johns Hopkins Bayview Medical Center. Samples were collected at the start of the session following 10 minutes of quiet rest, and again at 50 minutes and at 90 minutes.

The study hypotheses concerned the relationship between a participant's prevailing level of ambulatory blood pressure and the person's characteristic level of cortisol, moderated by a stable psychological disposition (agonistic striving). Thus it was important to characterize the participant's tonic cortisol level. We sought to approximate a characteristic morning cortisol level for each participant by computing the average of the three samples obtained during the clinic visit, as averages are expected to be more reliable than individual scores. Prior to computing the average, in order to determine if this approach would be valid, we computed the Cronbach alpha as a lower bound estimate of reliability (30). The resulting value, $\alpha = .76$, indicated good internal covariation among the three cortisol samples and supported averaging them together to yield a single cortisol mean to index cortisol level. Given that this index demonstrated good internal reliability, we decided that it could be used to test hypothesized inter-individual differences.

Motive Profiles

Social Competence Interview (SCI)—Implicit action goals that shape behavior and responding in chronically threatening situations were assessed with the SCI (3, 15, 31, 32), which measures one's ability to generate effective action strategies in real-life circumstances (Interview manual is available from the first author). In the first 5 minutes of the 10-min protocol, the participant is asked to describe a recent situation that typifies a recurring personally stressful problem (chronic threat) and to re-experience the feelings, sensations, thoughts, and impulses that the situation evokes. In the second 5 minutes, the participant is

asked to imagine that he or she is making a film about a person like the participant who has a similar problem. The goal is to invent a desirable but realistic ending for the film and to explain how that ending might come about. Finally, the participant is asked to explain how the imaginary film character's problem-solving goal and strategy might apply to his or her own stressful problem. The interviewer—a research assistant trained by the first author—was unaware of the study hypotheses.

SCI Goal / Expressiveness Scales—Implicit goals that generate recurring stress are inferred from the imagined film ending and problem-solving strategy using a behavioral coding system. Examples of agonistic goals include trying to get others to be more friendly/sympathetic/ cooperative, or less demanding/critical/hostile. Examples of transcendence goals include seeking to improve one's performance, attain a valued standard, overcome a personal defect, or live up to others' expectations. The degree of goal immersion is indexed by ratings of emotionally expressive, emphatic speech assessed by an Expressiveness scale; items include "speaks emphatically," "speaks loudly," "speaks rapidly," and "voice easily expresses emotion." Descriptions of scale content are provided in a coding manual available from the first author (33). The SCI scales have high internal consistency across studies (e.g., (3, 15), and have adequate temporal stability over a three-month period (15). SCI audio recordings were rated by coders trained by Craig Ewart; goal items were rated on 5-point scales (1 = *not at all*; 5 = *very much*).

Goal coding procedure—Coders were 5 graduate students in clinical psychology trained and supervised by Craig Ewart. Approximately 50% of the interviews were independently rated by at least two coders. Inter-rater reliability scores were calculated using procedures previously described (15). Pearson product-moment correlations among pairs of raters were in the acceptable range: .84 to .94 for agonistic strivings, >.92 for transcendence strivings, and >.90 for emotional expressiveness.

Negative Affect

Depressive/Dysphoric Symptoms—Symptoms of depression/dysphoria were assessed with the *Beck Depression Inventory* (34), a 21-item self-report questionnaire that asks participants to indicate if they experience each of 21 symptoms of depression or dysphoria. The BDI demonstrated good internal consistency in this sample (Cronbach alpha = .90).

Trait Anger and Hostility—These traits were assessed with the 7-item Anger and the 8-item Hostility subscales of the *Buss-Perry Aggression Scale* (35). Both scales exhibited good levels of internal consistency in this sample as indicated by Cronbach alphas: Anger, .77; Hostility, .81.

Ambulatory Blood Pressure

A Suntech Medical Oscar-2 Ambulatory Blood Pressure Monitor was fitted to the participant's non-dominant arm. Participants were instructed to hold the arm motionless during cuff inflation and recording. The device was programmed to record blood pressure every 30 minutes during the participant's normal waking hours and once every hour during sleep. At each cuff inflation, participants used a personal electronic organizer (Palm Zire

22™) to report their present activity/posture, and if during the previous 10 minutes they had consumed caffeine, alcohol, tobacco, or food, or interacted with someone.

Analytic Approach

Data preparation—Oscar 2 readings that could be matched with a corresponding electronic survey within a 5-minute interval were used for the statistical analyses. Missing or unusable readings were largely attributable to occasional Oscar malfunctions, bathing, sleep-cycle differences, and variations in study start times. All readings accompanied by Oscar codes indicating air leaks, microphone difficulties, or weak/absent oscillometric signals were excluded from the analysis. The data were edited following the criteria of Marler and colleagues (36): means and *SD*'s of blood pressure were computed separately within each activity category within females and males. If the difference between systolic and diastolic pressures was 0 or exceeded 90 mm Hg, then both readings were deleted. Systolic pressures >250 mm Hg or < 70 mm Hg, and diastolic pressures >150 mm Hg or <45 mm Hg, were deleted, as were readings that fell outside the range of values defined by the formula: of systolic/diastolic pressure >3 or < (1.065 ± 0.00125*DBP). If either the systolic or the diastolic reading was considered invalid, then both readings were removed from further analyses. Editing led to the removal of about 13% of the Oscar readings, and yielded an average 17 usable ambulatory blood pressure/ electronic diary readings during waking hours per participant. The mean of the readings recorded when awake was used as the dependent variable because agonistic striving is assumed to foster states of alert vigilance during daily activities.

Goal taxonomy—The hypothesis that the Agonistic, Transcendent, and Dissipated motive profiles would be replicated in PH6 was tested by performing a combination of hierarchical and *k*-means cluster analytic procedures to identify the number of motivational subgroups in the sample and to define the distinctive profiles of goals and expressive behaviors that characterized them (37, 38). These procedures are described in detail elsewhere (6).

Testing Moderator Effects—The hypotheses that agonistic striving, depressive symptoms/dysphoria, trait anger, and dispositional hostility each strengthen (i.e., moderate) the association between increased cortisol levels and higher prevailing levels of diastolic blood pressure were evaluated in four separate sets of statistical analyses. In each analysis, the mean level of ambulatory diastolic blood pressure when awake was regressed on the mean level of cortisol during the 90-minute clinic visit, one of the four proposed moderators (Agonistic Striving, Depressive Symptoms, Anger, Hostility), and the cortisol-by-moderator interaction term. BMI, calculated as weight/height² (kg/m²), and sex, two biological variables that consistently were linked to significant blood pressure variations in previous Project Heart studies, were selected a priori for inclusion as covariates in the statistical tests of study hypotheses. Potential covariates that had shown varying degrees of association with blood pressure in past research, and that were not specified by our guiding theoretical model, were examined but not included in the tests of statistical moderation because they did not interact with Agonistic Striving to predict blood pressure levels (described below). Those latter variables included race, consumption of food, alcohol, or tobacco, and posture/activity

levels (lying down, sitting, on feet standing/walking/climbing stairs) during blood pressure monitoring.

All regression analyses testing the predicted moderator effects used the GLM approach to regression with SAS, and were performed in two steps. The first step included BMI and sex as covariates, the moderator variable, and mean cortisol level. The second step added the interaction between the moderator variable and mean cortisol level to the step-one model. Where a statistically significant interaction was observed, the nature of interaction was ascertained by performing a simple effects analysis to see how the association between the mean cortisol level and mean diastolic pressure varied across different levels of the moderator variable. Although diastolic blood pressure was the primary focus of these tests, subsequent ancillary analyses using the same statistical models were performed to determine if cortisol and the moderator variables also predicted higher prevailing levels of systolic pressure and mean arterial pressure.

Results

Preliminary cluster analyses of the SCI scores of all PH6 participants ($N = 198$) tested our first prediction, which was that young adults who had grown up in high-stress urban neighborhoods would exhibit the hypothesized taxonomy of agonistic, transcendent, and dissipated regulatory strivings. Subsequent analyses with a subsample of participants ($N = 99$) who provided cortisol data tested our second prediction that agonistic striving moderates the association of higher cortisol with elevated blood pressure, and our third prediction that this effect will not be explained by negative affective dispositions indexed by depressive symptoms/dysphoria, trait anger-proneness, or dispositional hostility.

Replicating a Taxonomy of Regulatory Strivings

The first prediction was tested by performing hierarchical and k -means cluster analysis and model validation procedures in the full PH6 sample ($N = 198$). Results supported a three-cluster solution, and revealed three profiles of SCI scale means that closely fit the predicted regulatory goal taxonomy of agonistic, transcendent, and dissipated motive profiles that had been observed in earlier studies of adolescents and adults (3, 5–7). Figure 1 shows the cluster profiles represented as T scores on the SCI Expressiveness, Agonistic Goals, and Transcendence Goals scales; clusters in the present sample (top of Figure 1) are juxtaposed with the cluster profiles (bottom of Figure 1) observed in two earlier studies of urban youth in Baltimore (PH3) and Syracuse, New York (PH5). Of the 198 PH6 participants, 38% fit the Agonistic Motive Profile, 34% fit the Transcendence Motive Profile, and 28% fit the Dissipated Motive Profile. Group comparisons indicated that the three clusters did not differ significantly with respect to sex, age, race, or trait affect (Depressive Symptoms = 10.00 (7.47); Anger = 14.47 (5.02); Hostility = 16.78 (6.03); all values of p exceeded $p = .15$). Further cluster comparisons in the subsample of 99 participants who provided cortisol data in the present study replicated these findings, and indicated that the clusters did not differ with respect to size (Agonistic = 39; Transcendent = 36; Dissipated = 24), BMI, or levels of salivary cortisol or blood pressure; the cluster means for each variable did not differ from the sample means: BMI = 29.9 (6.2); salivary cortisol = 0.37 (0.2) nmol/l; SBP = 121.2 (9.6)

mmHg; DBP = 78.7 (9.7) mmHg. Nor did the clusters differ in the proportion of blood pressure measurements associated with social interaction, posture/activity level, or the consumption of tobacco, caffeine, food, or alcohol (all values of $p > .15$). Further analyses that regressed ambulatory blood pressure on each of these covariates in separate regression analyses indicated that none of the variables interacted significantly with cluster membership to predict blood pressure levels.

Does Agonistic Striving Moderate Cortisol's Association with Blood Pressure?

Having replicated the three predicted motive profiles in this sample, it now was possible to test the second prediction, which was that the association between increased cortisol levels and prevailing levels of ambulatory diastolic blood pressure will be stronger in persons with the agonistic striving profile compared to the transcendence striving or dissipated striving profiles. In step one, statistically significant main effects were observed for BMI and sex, indicating that greater body mass and being male were associated with higher prevailing DBP. The main effects of Motive Profile group and Cortisol were not statistically significant. In step two, the main effect for Motive Profile group and the interaction between Cortisol and Motive Profile group were statistically significant ($F(2,91) = 4.17$; $p = .019$, and $F(2,91) = 6.71$; $p = .002$, respectively).

Analyses of simple slopes indicated a positive association between Cortisol and ambulatory DBP in persons with the Agonistic profile, $b = 16.09$ ($SE = 5.89$), $t = 2.73$, $p = .008$, and a negative association in those with the Transcendent profile, $b = -20.11$ ($SE = 9.53$), $t = -2.11$, $p = .038$; there was no significant association in persons with the Dissipated profile, $b = -14.01$ ($SE = 10.96$), $t = -1.28$, $p = .20$. Analyses of simple effects indicated a significant slope difference between the Agonistic group and the Transcendent group, $t = 3.26$, $p = .002$, and the Agonistic group and the Dissipated group, $t = 2.40$, $p = .018$; the Transcendent and Dissipated groups' slopes were not significantly different, $t = 0.42$, $p = .68$. The significant group slope differences are shown in Figure 2. A single slope is shown for the Transcendent and Dissipated profile groups combined ($b = -17.06$ ($SE = 7.21$), $t = -2.37$, $p = .020$) because their slopes did not differ significantly.

The same analytic approach then was used to test models predicting levels of ambulatory systolic pressure and mean arterial pressure. In the model predicting SBP, no statistically significant main effects or interactions were observed for Cortisol or Motive Profile (all values of $p > .67$). In the model predicting MAP, only the Cortisol-by-Motive Profile interaction term was significant ($F(2, 91) = 4.31$; $p = .016$). The pattern of statistically significant simple effects observed for MAP was identical to the pattern observed for DBP, except that in persons with the Transcendent profile, the negative association between Cortisol level and MAP was not significant, $b = -15.15$ ($SE = 8.70$), $t = -1.74$, $p = .085$.

Are the Moderating Effects of Agonistic Striving Explained by Negative Affect?

A final set of analyses tested the third prediction, which proposed that the moderating effect of agonistic striving on the association of elevated cortisol and high blood pressure is not explained by negative affective dispositions indexed by depressive symptoms/dysphoria, trait anger-proneness, or dispositional hostility. Testing this prediction entails two separate sub-

analyses. First, it is necessary to test the hypothesis that each of the three negative affective dispositions is associated with higher blood pressure levels directly, or indirectly (i.e., by interacting with cortisol). Second, where significant associations between negative affect and blood pressure are detected, subsequent analyses are needed to determine if agonistic striving moderates the association of cortisol with blood pressure after controlling for the negative affect variable.

Symptoms of Depression/Dysphoria—No statistically significant main effects of Depressive Symptoms in regression analyses modeling DBP were detected. Nor was the interaction between Depressive Symptoms and Cortisol statistically significant ($F(1, 92) = 3.46$; $p = .066$). Ancillary regression models with SBP and MAP yielded the same result.

Trait Anger—No statistically significant main effects of Anger or its interaction with Cortisol in regression analyses modeling DBP were detected (all values of $p > .66$). The same result was obtained in ancillary regression models with SBP and MAP.

Hostility—No statistically significant main effects of Hostility or its interaction with Cortisol in regression analyses modeling DBP were detected (all values of $p > .45$). The same result was obtained in ancillary regression models with SBP and MAP.

Considering that none of the negative affective dispositions predicted ambulatory blood pressure levels in any of the statistical models, there was no reason to test models that regressed blood pressure on cortisol level, agonistic striving, and the interaction of these two predictors after controlling for the association of blood pressure with negative affect. These results are consistent with the hypothesis that the observed relationships among elevated cortisol levels, agonistic striving, and their interaction in predicting higher blood pressure are not explained by negative affective traits or hostile attitudes.

We considered, however, that a reader's curiosity might be piqued by the “nearly significant” ($p = .066$) Depressive Symptoms-by-Cortisol interaction term. We therefore analyzed this interaction by performing tests of simple effects that regressed diastolic pressure on Depressive Symptoms at different levels of Cortisol (> 1 SD below mean; Mean ± 1 SD; > 1 SD above mean). These analyses revealed that none of the 3 simple slopes met the critical .05 criterion. The p -values of these slopes were, respectively, $p = .27$, $.90$, and $.13$. A separate analysis that regressed diastolic pressure on Depressive Symptoms, controlling for BMI and Sex, disclosed that the main effect of Depressive Symptoms was not statistically significant ($F = 0.53$; $p = .45$). Thus we concluded that testing the moderating effects of Agonistic Striving in a regression analysis that controlled for Depressive Symptoms would not add useful information, and might even be misleading (e.g., by capitalizing on a statistical artifact).

Discussion

Our understanding of stress processes in cardiovascular disease still owes much to the vivid early portrait of the Type A striver, struggling against the world, relentlessly seeking achievement, power, and recognition (39, 40). This picture changed as researchers focused

on the striver's hostile attitudes and angry emotions (41), and worked to build interpersonal and social-competence models of stress-prone struggles (2, 15, 31, 42–44). The foundational Type A strivings, it turned out, were much too broad and too abstract for rigorous scientific analysis (15). Expansive goal categories such as striving for *achievement*, *power*, or *recognition*, widely overlap (45). These constructs, like many goals studied in health research—goals such as *purpose-in-life*, *autonomy*, *self-esteem*, or *sense of coherence*—are defined at a fairly high level of abstraction. This makes it difficult to devise testable causal models that specify how a widely inclusive and highly abstract goal generates a predictable pattern of cognitive, affective, and behavioral responses that reliably alters the operation of a physiologic mechanism. Thus many motive constructs in the cardiovascular research literature may be useful for linking broad psychosocial markers to illness risk but not very useful for elucidating the causal *mechanisms* of a particular disease.

The social action theory of chronic psychological stress addresses this problem by identifying non-overlapping categories of theoretically grounded, risk-related regulatory strivings that can be specified at a level of abstraction that is optimal for mechanistic causal modeling. The present theory-derived, empirically grounded goal taxonomy of agonistic, transcendent, and dissipated strivings now has been replicated in five different community-based samples of widely varying ages, SES levels, and ethnic compositions. In each sample, cluster analyses of SCI goal-focus and goal-immersion indices consistently have yielded three subgroups with the predicted motive profiles, each of which characterized a cluster containing from 23% to 41% of the participants in each sample (3, 5–7). These three striving profiles transcend problem domains (e.g., familial, social, occupational, financial), and occur with equal frequencies across differences of sex, race, age, and geographic region. In all demographic groups, persons who exhibited the agonistic striving profile were at greater illness risk relative to persons who exhibited the transcendent or dissipated profiles. Present findings replicate this taxonomy in a largely African American community-based sample of young urban adults who grew up in high-stress city neighborhoods. As in previous research, agonistic goals and transcendence goals are seen to represent distinct, non-overlapping motive constructs. As Figure 1 indicates, individuals who score high on either goal score low on the other. This research suggests, further, that a high degree of immersion or emotional investment in an agonistic goal, indexed by the SCI Expressiveness score, interacts with cortisol regulation mechanisms to elevate blood pressure levels as predicted by social action theory.

The study's findings have implications for identifying high-risk population subgroups and for tailoring health protective interventions. First, the ability to specify strivings by the direction of goal focus and the degree of goal immersion, and to model how strivings interact with response modulation mechanisms, makes it possible to identify persons with higher-risk profiles. Previous research has shown that ambulatory blood pressure levels were significantly higher in that subgroup of youths who exhibited the agonistic profile and *also* displayed: (a) greater difficulty regulating anger during a structured laboratory challenge (3), or (b) lower teacher-rated self-control abilities in the classroom (16). Another study of adolescents and young adults found that levels of somatic symptoms were higher in the subgroup of persons who exhibited the agonistic profile and also displayed greater difficulty in modulating responses to painful stimuli during a graduated thermal pain tolerance task

(5). In a study of middle-aged adults receiving outpatient treatment for alcohol use disorder, agonistic goals interacted with poor anger-regulation abilities to predict earlier relapse following treatment (7). In the present study, cortisol levels predicted higher blood pressure levels only in those individuals who exhibited the agonistic striving profile. Together, these findings suggest that beneficial effects of stress management interventions may be missed when researchers study response modulation processes without examining how their health effects are moderated by regulatory goals. Robust emotion regulation abilities are widely thought to be protective factors that may buffer disadvantaged youths against early adversity (46–48). However, the accumulating evidence suggests that such capabilities may protect health largely in the particular subgroup of young persons whose social environments induce persistent agonistic struggles (8).

Present findings also have implications for tailoring protective interventions. One of psychosomatic medicine's enduring challenges is the problem of clarifying how illness-prone cognitions, emotions, and behaviors operate separately or together to shape disease risk. Present results address this important question by suggesting a means to clarify these relationships. Social action theory distinguishes between a goal, which represents an intention to act, and an emotion, which represents an evaluation of a change in somatic awareness (18, 49). This distinction implies that an agonistic goal may induce cardiovascular responses even when one is not feeling emotionally aroused or upset. For example, a state of alert mental vigilance to potential social-environmental challenges may increase blood pressure even when one does not feel anxious or angry. Prior research evidence supports this: Agonistic striving is associated with greater anger arousal during the SCI, yet the link between agonistic striving and illness risk is not explained by greater anger reactivity to personal stress, nor by negative affective dispositions such as trait neuroticism, anxiety, anger, depression, hostility, internalizing behaviors, externalizing behaviors, or low self-esteem, nor daily in-vivo ratings of negative affect—variables on which the three motive profile groups do not differ (3, 5, 7, 16). Present findings offer new support for this view by indicating that agonistic striving represents a distinct cognitive causal mechanism that may shape health outcomes independently of attitudes or emotions.

Yet accumulating evidence does suggest that agonistic striving has emotional correlates that could endanger health over the long term. Prior research comparing individuals with the agonistic striving profile to individuals with the transcendence striving or dissipated striving profiles indicates that the agonistic strivers tend to become angrier when recalling a occasion when their attempt to influence someone was thwarted (3, 6, 7). The evidence suggests that this reactive agonistic anger is situationally specific, and serves social control motives in circumstances where interpersonal control is threatened or uncertain (3, 50). Thus it is not anger's overall frequency, but rather its situational trigger and social influence function that characterizes persons with the agonistic profile. Although reactive agonistic anger during the SCI has not been found to predict health outcomes, angry responses do have the potential to shape one's interpersonal environment in ways that can undermine social support and generate recurring stress. Thus, whereas agonistic goals may impair cardiovascular health by contributing to hypertension, reactive anger may shape one's interpersonal milieu in ways that lead to recurring distress. Stressful social environments may foster hostile beliefs and attitudes that increase cardiovascular risk (42).

This implies that behavioral interventions to protect health by enhancing stress management abilities may need to identify and reshape agonistic regulatory strivings. Although interventions that are designed to dampen stress responses by regulating negative emotions, including anger, anxiety, and sadness, may benefit nearly everyone, the measurable health benefits may occur largely in persons with the agonistic striving profile. Present evidence suggests that interventions may be more beneficial when they specifically target agonistic striving, and also encourage positive self-development goals associated with transcendence striving (cf., (3). The potential benefit of fostering transcendence striving is consistent with the finding that post-hoc analyses of profile group slopes disclosed that cortisol and ambulatory blood pressure levels were *negatively* correlated in the transcendence striving group. Prior research suggests also that it may be important to train agonistic strivers to be aware of when, where, and how they experience anger, and to express angry emotions in ways that do not provoke hostile counter-responses (3).

The study's limitations must be considered when weighing its implications. One limitation is the assessment of cortisol levels with three saliva samples on a single occasion within three hours after awaking—a protocol dictated by the need to also collect a fasting morning blood sample during a single clinic visit. This precluded an accurate assessment of the influence of factors such as circadian changes, the cortisol awakening response, or reactivity to the experimental situation, any or all of which may affect the reliability of individual differences in cortisol levels [e.g., (51). Replication studies that control for these factors are needed. Other relationships among HPA regulation, cognitive regulatory strivings, negative affect, and ambulatory blood pressure may have been detected had it been possible to assess diurnal cortisol curves or patterns of variation over successive days or weeks (22, 52). More intensive extended sampling of negative affect with in vivo diary methods may well have yielded valuable insights into the role of emotions and affect regulation processes. Cardiovascular risk was indexed by mean levels of ambulatory blood pressure while awake during two 24-hour periods. Although elevated blood pressure is regarded as an excellent indicator of increased allostatic load (26), more comprehensive assessment of allostatic accommodation would have included additional physiologic indices. Finally, as an observational study, the present design did not permit the experimental evaluation of hypothesized causal mechanisms.

Implications are indicated also by the study's strengths, which include its substantial community-based, largely African-American sample of young urban adults who had spent most of their lives in stressful city neighborhoods (9). Other strengths include the use of an ecologically valid behavioral observational method (the SCI) to assess implicit action goals, as well as a guiding theoretical model that made it possible to predict and test interactions between well-specified neurohormonal and cognitive processes. Future research might include information about the participants' attempts to assert interpersonal control provided by friends and family members, as these perspectives may shed further light on agonistic striving (53, 54).

Together, present and prior evidence indicates that implicit goals, response-regulation processes, and emotions represent qualitatively different phenomena that may operate in concert to shape human health and wellbeing from youth into adulthood. The ability to

separate these mechanisms, and to test models specifying the manner in which they combine and interact to affect health outcomes, represents an important conceptual advance beyond formulations that treat psychosocial influences only as broad dispositions or omnibus traits (cf. (55). Social action theory distinguishes between motives that increase stress exposure, regulatory capabilities that modulate stress responding, and subjective emotional responses that affect personal wellbeing and shape social environments. These components may interact in diverse ways. Each one suggests specific, differing interventions to lower stress responding and enhance health.

The social action theory model now has been supported with evidence from studies of widely differing illnesses conducted for more than a decade at different research centers with different teams of SCI interviewers and observers/coders. Thus it will be important in future work to include efforts to further expand this evidence base by seeking replications and convergent results from other research labs. Needed also will be work to integrate social action theory's causal analysis of implicit motives and response modulation mechanisms into the extensive literature on psychosocial variables predicting illness risk (56–58).

Acknowledgments

Source of Funding: This research was supported in part by grant R01-HL084333 from the National Heart, Lung, and Blood Institute, awarded to Craig K. Ewart.

Abbreviations

HPA	hypothalamic-pituitary-adrenal
SCI	Social Competence Interview
BMI	body mass index
DBP	diastolic blood pressure
SBP	systolic blood pressure
MAP	mean arterial pressure

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Figure 1.

Three motive profiles (Agonistic Striving, Transcendent Striving, Dissipated Striving) generated by cluster analyses of *T*-scores on the Social Competence Interview for Expressiveness (EX), Agonistic Goals (AG), and Transcendent Goals (TG) scales in the present study of Baltimore adults (above) and in two earlier studies of adolescents (below) in Baltimore (6) and Syracuse (3).

Figure 2.

Interaction between mean saliva cortisol level and implicit Motive Profile group in predicting the mean level of ambulatory diastolic blood pressure while awake. The slope of the Agonistic profile group is contrasted with the slope of the Transcendent profile and Dissipated profile groups combined (Standard errors: Agonistic profile group = 5.89; combined Transcendent + Dissipated profile group = 7.21).