Patterns of Change in Hostility from College to Midlife in the UNC Alumni Heart Study Predict High-Risk Status

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Objective: To examine hostility measured in college and patterns of change in hostility from college to midlife as predictors of high health-related risk later in midlife. **Methods:** Logistic regression models were used to test hostility/risk associations. **Results:** College hostility predicted being a current smoker, consuming more than two drinks of alcohol, low social support, achieving less than expected in career and in relationships, risk for depression, and appraisal of life changing for the worse in terms of family events at midlife. Change in hostility did not predict smoking and drinking; however, it did significantly predict social isolation, lower income (only for women), obesity, avoidance of exercise, high-fat diet, and negative changes in economic life, work life, and physical health events–all risk indicators measured during the next decade. Appraisals of social support, lowered expectations, risk for depression, and reports of family life changing for the worse were predicted at both time periods. When change in hostility was modeled with college hostility, all risk indicators were significantly predicted by college hostility. **Conclusions:** High hostility in college and change in hostility from college to midlife predicts a full range of health risk indicators. When compared with the average population decline in hostility, gains in hostility at midlife are related to increased risk while declines in hostility are related to reduced risk. Higher midlife hostility is associated with increased odds of being in the higher risk group. Future research should focus on developing interventions to reduce hostility. **Key words:** hostility, age, patterns of change, health risk, risk trajectories.

CHD = coronary heart disease; **HT** = hypertension; **MMPI** = Minnesota Multiphasic Personality Inventory; **UNCAHS** = University of North Carolina Alumni Heart Study; **SES** = socioeconomic status; **CESD** = Center for Epidemiological Studies of Depression Scale.

INTRODUCTION

Psychosomatic medicine has been concerned with the role of psychosocial risk indicators that predispose people to disease including traditional personality factors, sociodemographic indices, depression, and social support (1–3). Behavioral risk indicators are not specific for disease outcomes. Although mechanisms of action are hypothesized to be different depending on the disease studied, health risk behaviors are deleterious for a number of diseases, including coronary heart disease, cancers, and mortality (4–5).

There has been a new appreciation of the role of age and risk (6, 7) in terms of the age at measurement of hostility as a predictor of CHD (8). Cross-sectional survey data collected in the 1950s (9) and again in the 1980s (10) and the 1990s (11) show a curvilinear relationship of hostility with age. That is, mean hostility reaches a peak in late adolescence and a nadir in middle age (12). Longitudinally, from middle to later life,

hostility appears to be stable or to increase slightly (11, 13). If the shape of the cross-sectional curve is a good representation of the longitudinal change in hostility, these two points–late adolescence and middle age–should represent maximal developmental change. Understanding how hostility affects high-risk behavior during the decades of the 20s to the 40s is important because there may still be time for prevention or delay in the development of CHD and cancers in middle-aged and older persons.

The measurement of change is a key concern of researchers in developmental psychology. In general, the emphasis on the measurement of change has been on change in a dependent variable and in understanding that change as a function of age. More broadly, it is also important to understand change or patterns of change–trajectories–as an independent variable– that is, as a predictor(s) of important outcomes in middle and later life (14).

Hostility has been one of the major constructs studied by researchers seeking to understand the role of personality in disease processes and health outcomes (15–17). The preponderance of evidence supports an important role for hostility. It is associated with the development of CHD (18–20), recurrent CHD (21), coronary artery calcification (22), CHD risk factors (23–27) and all-cause mortality (18, 19, 28), especially in prospective studies started on older samples (29, 30). There are also four negative prospective studies (31–34) that are discussed by Barefoot in (35). Because none of these negative studies deal with hostility and health risk behaviors, they are not reviewed further.

The Cook-Medley hostility scale (36) from the MMPI (37) is a major measure of hostility. Research has been done with the total scale and subsets and various scoring algorithms (20, 21, 28). The cross-time correlation coefficient of hostility varies with the age at initial measurement as well as the length of time between assessments such that cross-time correlations from college to adulthood are around 0.40 (with 20–30 years of time between measures) (38) and around 0.80, after age 40 with about 4 years of follow-up observation (19).

HOSTILITY, HOSTILITY CHANGE, AND HEALTH RISK

Previous findings from the UNC Alumni Heart Study (23) indicate that smoking, caffeine consumption, body mass index, alcohol use in the past week, and lipid ratio measured in 1987 to 1988, were prospectively predicted by higher levels of hostility in college (1964–1965). The only health risk behavior at midlife not predicted by hostility in college was amount of exercise–high hostile people exercised more. The measures of hostility used in the previous paper are the same as in the present paper. In the present paper, we assess new risk indicators measured from 1990 to 1998 (social support, economic status, negative appraisals of categories of life events, obesity, avoidance of exercise, risk for depression), and update continued smoking 7 years later. The focus of this paper is on high-risk endpoints (39) rather than associations of hostility and mean levels of risk indicators (12, 23, 24). The study of high-risk behavior is important because risk modification in the first half of the lifespan may reduce the likelihood of subsequent morbidity and earlier-than-expected mortality.

METHODS
Subjects

Respondents in the UNC Alumni Heart Study (40) were included in the present analyses if they had a valid assessment of hostility at college entry in 1964 to 1965 and at the 1988 study follow-up. Participants were excluded if they were not between 16 and 19 years of age at the time of college assessment. There were 2200 participants with hostility assessed at both college and follow-up. The group was primarily male (86.32%) and white (~99%). In college, the mean age was 18.3 years with a standard deviation of 0.5 years. At midlife, the mean age was 41.3 with a standard deviation of 1.0 years. The number of participants in each analysis varied according to the availability of data for a particular risk indicator. Long-term participation in the UNCAHS is excellent.

Measurement of Hostility

The Minnesota Multiphasic Personality Inventory (37) was given at college orientation or registration. The MMPI contains 50 items that comprise the Cook-Medley Hostility Scale (36). As part of the second UNCAHS follow-up in 1988, approximately 23 years later, individuals answered the 50 hostility items. Hostility was set to missing if more than 10% of the items were left unanswered.

Timing of Measurement of Risk Indices

The UNCHAS is a mail survey. Each questionnaire measures related constructs designed to be completed in a reasonable time (10–30 minutes) to enhance response rates. Study participants are contacted every 1.5 years. Table 1 contains the timing of the variables, the time since measurement of college hostility and midlife hostility, and the mean age of the subjects when the risk indicators were assessed.

Social and economic variables were in the third questionnaire mailed in 1990 ($N = 2059$); exercise was in the fifth questionnaire, mailed in 1993 ($N = 1774$); depression, diet, and weight were in the sixth questionnaire mailed in 1994 ($N = 1745$); and the changes in life domains were in the seventh questionnaire mailed in 1997 ($N = 1544$). Over 95% of the sample (96.6%–99%) had complete data for each risk outcome. Depending on the specific measure, risk indicators were assessed 24 to 31 years after the college measure of hostility and 1 to 9 years after the 1988 midlife assessment of hostility.

Defining High Risk

The risk indicators tested in this paper fall into three conceptual categories: a) traditional health risk behaviors that have been shown to be related to heart disease (39) and cancers (41); b) achievement indicators reflecting the motivational underpinnings of Type A Behavior Pattern (42) and lower-than-expected income (1, 4, 43); and c) negative affect and appraisals–here indexed by risk for depression and reports of negative life events associated with the development of CHD (44, 45). Where available, endpoints in the literature for a specific risk indicator were used. For the remaining indicators, sample frequency distributions were examined and appropriate conceptual or empirical cut points were chosen. It is important to note that these define extreme groups within the population and are the target for risk reduction by Healthy People 2000 (41).

Traditional Health Risk Behaviors and Social Factors

Smoking remains a major public health problem and continued smoking increases the risk for many diseases (46). Exercise reduces the risk for many chronic diseases; thus, reporting no regular physical activity and a general avoidance of walking and exertion (47) were defined as high risk (48)(avoid exercise). Obesity was categorized as reporting a BMI > 30 kg/m^2 (49). Excess alcohol consumption was defined as > 25 g/d (> approximately 2 drinks/day) (50) with a serving of beer equal to 13 g, a serving of liquor equal to 15 g, and a serving of wine equal to 10 g, making an average serving equal 12.5 g of alcohol. When stratified by type of alcohol, there were insufficient heavy drinkers for each type of alcohol to be analyzed separately. Greater than 37% calories from fat defined a high-fat diet. Alcohol and fat were measured in a customized food frequency questionnaire (51). Briefly, pretests were used to determine the food items and portion sizes. Reports on the 161 food items and all extra foods listed were analyzed by the Food Intake Analysis System (52), which used the USDA database version 2.3 (53). Social isolation was defined as reporting that one visits with an average of one or fewer friends or relatives each month (54). Social support was indexed by the appraisal scale of the Interpersonal Support Evaluation List (ISEL) (55). Inadequate social support was defined as the bottom 10% of the present cohort. Within this collection of seven traditional risk indictors, 46.4% of the sample was categorized as low risk on all of the indicators; one individual was categorized as high risk on all of the indicators.

Achievement Indicators

Lower socioeconomic status (SES), including income (56), is related to poorer health (43). In the UNCAHS, high risk was defined as a household income below the US median family income for 1990 (57) (approximately $30,000–$34,000) and was conceptualized as a measure of economic achievement (median income in this study is in the $60,000–70,000 per year range) (58). Study participants were asked, "In terms of what you expected when you were in college: 1) how would you best describe your career achievements to date, and, 2) to what extent have you attained what you wanted in personal relationships?" The risk cut point for unachieved career

TABLE 1. Timing of risk indicators

Variable	Years after Measurement of College Hostility	Years after Measurement of Adult Hostility	Mean Age (SD) at Measurement of Risk Outcome
Social and economic factors	24.3	1.3	42.6 (1.0)
Exercise	27.6	4.6	45.9 (0.9)
Smoke, drink, diet, depression	29.1	6.1	47.4 (1.0)
Changes in life areas	31.9	8.9	50.2 (1.0)

and relationship goals was defined as reporting "less than I expected" to each item. Within this grouping of indicators, 54.4% of the sample was low risk on all areas and 2.3% were high risk on all three indicators.

Negative Affect and Appraisal

Risk for depression was assessed with a score of at least 16 on the 20-item Center for Epidemiologic Studies Depression Scale, which is a self-report of depressive symptoms sufficient to suggest that further evaluation is needed (CES-D)(59). This is an index of risk, not of clinical depression (60). Change in one's life situation was assessed for family life, work life, economic life, and physical health. Participants were asked to rate their appraisal of change in each area since 1991 as follows: "stable", "changing for the better", or "changing for the worse" (61). High risk was defined as reporting "changing for the worse". Within this set of indices, 54.6% were low risk on all indicators, less than 1% ($N = 10$ persons) were high risk on all indicators; and 59.4% reported no changes for the worse in any of the four areas, while 1.0% reported changing for the worse in all four areas.

In general, gender differences in the distribution of risk were as expected: the high-risk groups for exercise behavior, depressive symptoms, and income contained a larger percentage of women than men, whereas the high-risk group for alcohol consumption was composed of a larger percentage of men than women. There were no other significant gender differences; however, gender was controlled in all analyses.

Statistical Analysis

Logistic regression models (62) were used to assess the effect of hostility in college as a continuous variable and then with hostility categorized as low, average, and high. Residualized change in hostility from college to midlife was also tested, first as a continuous variable and then as patterns of change (gain, stability, large decline, average decline) as predictors of high-risk indicators during midlife. Residualized change models that control for college hostility were used for the following reasons: they are more reliable as compared with non-residualized scores, they adjust for regression to the mean, and they provide a measure of gain not otherwise predictable from the participant's college status (63). Gender was controlled in all models. Each model initially contained a gender by hostility interaction term and interaction terms for college hostility by change in midlife hostility. Interaction terms that were not statistically significant ($p < .05$) were removed in final models. The only significant gender interaction was for hostility change predicting lower income for women but not for men.

To enhance our understanding of the continuous models, categorical models were calculated for college hostility comparing low to average hostility and high to average hostility. Patterns of change in hostility were calculated with reference to average decline over time for a large decline, stability, or a gain. These patterns of change in hostility define distinct trajectories. Their distribution is shown for the total sample in Table 2. As an aid to understanding the models treating hostility as continuous variables, we fitted additional logistic models for our categorized hostility. Odds ratios for

TABLE 2. Hostility in college by patterns of change from college to midlife

| College Hostility | Patterns of Change from College to Midlife | | | | |
	Drop	Average	Stable	Gain	Total
Low: 0–12	38	97	137	219	491
Average: 12+ −21	348	271	183	149	951
High: > 21	563	95	67	33	758
Total	949	463	387	401	2200
%	43.1%	21.1%	17.6%	18.2%	100%

Drop is defined as a change > -6 points; Average is a drop of -2.01 to -6 points; Stable is $0 +/-2$ points; Gain is $> +2.01$ points.
Chi-Square $= 709.02$ (6), $p < .0001$

these analyses are shown in the figures for combined college and change level hostility.

RESULTS

The correlation between college and midlife hostility measured 23 years later was $r = +0.39$. The correlation between college hostility and change in hostility was $r = -0.66$. The mean change in hostility from college to midlife was a decline of 4.61 points (SD $= 7.89$). The range of individuals' change score was from $+22$ to -32; almost two thirds of the individuals become less hostile with age. The patterns of change were tested with reference to the average decline (-6 to -2 points). As shown in Table 2, approximately equal percentages of the sample were stable (-2 to $+2$) or had a gain in hostility over time ($\sim18\%$). The distributions of patterns of change or trajectories for each level of college hostility show how the change was distributed.

Table 3 provides the results of the logistic regression models used to assess hostility scores measured at college as predictors of adult risk and Table 4 provides the results of change in hostility as predictors of adult risk. Odds for one standard deviation in hostility or change in hostility as a continuous variable are then shown with the confidence intervals. The final columns give the odds for high or low hostility versus average college hostility in Table 3 or gain, stability, and decline versus average change in hostility over time in Table 4. All odds ratios are provided, with those that are statistically significant shown in **bold**.

Hostility in College

The sample mean for hostility assessed in college was 18.6 (SD $= 7.7$). Being a current smoker, drinking more than two drinks per day on average, perceiving social support as inadequate, risk for depression as indexed by high depressive symptoms, perceptions of lowered achievements in career and relationships, and life changing for the worse in the domain of family events were significantly associated with higher college hostility over the 30-year period. College hostility was unrelated to avoidance of exercise, obesity, dietary indicators of a high-fat diet, reports of being socially isolated, achieved income less than the national average (23 years later) and reports of physical health, work, and economic life changing for the worse in the previous 10 years was predicted over 30 years later. None of the gender by hostility interaction terms reached statistical significance for college hostility. For all significant effects, membership in the risky category was associated with higher hostility in college. In the categorical models, low versus average hostility was never significant. High versus average hostility was risky for smoking, alcohol use, having achieved less than expected in relationships, and risk for depression.

Residualized Change in Hostility from College to Midlife

The sample mean for hostility assessed at midlife was 14.02 (SD $= 6.4$). The logistic regression used to assess changes in hostility from college to midlife as a predictor of

TABLE 3. College hostility and risk: continuous and categorical models adjusted for gender

Risk Indicators	% in High Risk Category	College Hostility; Continuous Model	Low vs. Average Category	High vs. Average Category
Current smoker	12.0%	**1.22 (1.05–1.41)**	1.03	**1.55**
Obese	11.9%	1.07 (0.92–1.25)	.79	1.08
Avoid exercise	3.8%	1.08 (0.84–1.39)	.62	.82
High-fat diet	21.0%	1.07 (0.94–1.20)	.77	.88
Excess alcohol	11.8%	**1.20 (1.03–1.39)**	.90	**1.50**
Socially isolated	6.3%	1.05 (0.87–1.25)	1.28	1.37
Inadequate social support	12.6%	**1.18 (1.03–1.34)**	.86	1.13
Achieved < median income	5.5%	1.14 (0.94–1.37)	1.00	1.44
Achieved < in career	25.2%	**1.19 (1.08–1.32)**	.81	1.18
Achieved < in relationships	30.1%	**1.16 (1.06–1.28)**	.87	**1.25**
Risk for depression	14.1%	**1.33 (1.16–1.52)**	.77	**1.50**
Family life changing for worse	13.0%	**1.20 (1.03–1.41)**	.90	1.36
Work life changing for worse	19.8%	1.10 (0.97–1.26)	1.03	1.32
Economic life for worse	9.9%	1.07 (0.90–1.27)	.83	1.01
Physical health for worse	17.6%	1.09 (0.95–1.25)	.87	1.17

Reference group for categorical models of college hostility was average hostility (12–21). Low hostility was < 12 and high hostility was >21.

TABLE 4. Continuous and categorical change in hostility from college to midlife, controlling for gender and college hostility

Risk Indicators	Odds of Risk for a 1 SD Increase in Hostility: Continuous Model[a]	Odds of Gain[b]	Odds of Stability	Odds of Decline
Current smoker	1.18 (0.97–1.42)[c]	1.28	1.19	.91
Obese	**1.47 (1.22–1.77)**	**2.23**	1.16	1.03
Avoid exercise	**1.50 (1.10–2.02)**	1.79	1.29	.92
High-fat diet	**1.25 (1.08–1.46)**	1.23	1.43	.99
Excess alcohol consumption	1.06 (0.87–1.28)	1.57	1.50	1.30[d]
Socially isolated	**1.46 (1.17–1.83)**	1.59	1.21	.74
Inadequate social support	**1.77 (1.50–2.09)**	**2.15**	**1.91**	.86
Achieved < median US income	**1.32 (1.04–1.69)****	1.35	.97	.70
For women	**2.36 (1.47–3.78)**	1.59	.95	**.10**
For men	1.16 (0.89–1.48)	1.24	1.09	.97
Achieved < expected in career	**1.50 (1.31–1.70)**	**1.94**	1.23	.87
Achieved < expected in relationships	**1.57 (1.39–1.79)**	**1.93**	**1.53**	.85
Risk for depression	**1.72 (1.45–2.05)**	**2.00**	1.22	.94
Family life changing for worse	**1.31 (1.09–1.59)**	1.19	.85	.76
Work life changing for worse	**1.31 (1.11–1.54)**	**1.81**	.97	.99
Economic life changing for worse	**1.50 (1.21–1.85)**	1.60	1.26	.67
Physical health changing for worse	**1.38 (1.17–1.64)**	1.13	1.21	**.66**[e]

Reference Group was defined as Average decline in hostility was defined as −6 to −2- or −4 +/−2 points; Gain is > 2 points; Stability is 0 +/− 2 points; and Decline is > −6 points (−6 to −32).
[a] Residualized change in hostility is calculated from models that have college hostility, midlife hostility, and gender.
[b] Residualized change in patterns of hostility is calculated from models that have college hostility as low vs. average and high vs. average (see columns 4 and 5, Table 3) and the gain, stable, and decline, three patterns in a second model.
[c] For smoking: OR = 1.20 (1.04–1.38) for a model with hostility at midlife and gender.
[d] For excess alcohol: large vs. average decline OR = 1.56 (1.03–2.37) for a model with hostility at midlife and gender.
[e] For change health for the worse: large vs. average decline OR = .80 (.56–1.14) for a model with hostility at midlife and gender.

high risk found that change in hostility was significant for all variables except for smoking and excess alcohol consumption. There was one gender interaction, such that change in hostility predicted lower income for women but not for men. These findings are shown in the second column of Table 4.

Patterns of Change

Odds ratios for the patterns of change are shown in the final three columns of Table 4. The average change in hostility (a decline of 4 points) was used as the comparison for each contrast. Larger than average declines–seen in the last column–are generally protective but not statistically significant. Maintaining stable hostility–not showing the normative decline–is risky for perceiving social support as inadequate and achieving less than expected in social relationships. Even more important for increasing risk are gains in hostility over college levels, which double the risk for obesity, inadequate social support, achievements less than expected, and the risk of depression.

A picture of the associations between college hostility and

change can be seen in Fig. 1 for inadequate social support and in Fig. 2 for risk of depression. Both of these variables were significantly predicted by college hostility and change in hostility. The odds ratios are different than those in the tables because the referent in the figures is the average decline in hostility at the average college level set to 1.0.

While the patterns of change are more extreme for those high in hostility in college, the overall pattern within levels of college hostility is similar. This was significant for depression but not social support as shown for the high versus average category (see Table 3). For social support, both stability and gain in hostility was associated with increased risk while for depression, only gain was associated with higher risk (see Table 4). When both college and change in hostility are in the model, both contrasts for low and high versus average hostility are significant for both variables (see Table 5). This can be seen by comparing the bars, which in these analyses were averaged across levels of college hostility (Figures and Tables of analyses not shown are available for the remaining variables upon request.).

College Hostility Modeled with Change in Hostility

A way to illustrate the results is to look at the impact of college hostility on adult risk in the same model that includes change in hostility from college to midlife. These analyses are presented in Table 5.

As can be seen from Table 5, the impact of college hostility is strengthened considerably when the information about change in hostility is included in the same model. All of the coefficients for college hostility are significant predictors of risk in the continuous models, and in the categorical models, low hostility is now protective for 10 of the variables while high hostility is risky for 12 of the variables.

DISCUSSION

The patterns of change analyses are particularly interesting. We identified four trajectories of change in hostility. Two of them involve declines in hostility, the average or normative decline of around 4 points, and a larger decline. Declines in hostility greater than average tend to be protective while stability tended to increase risk, although these were only statistically significant for two variables in each case. Gain in
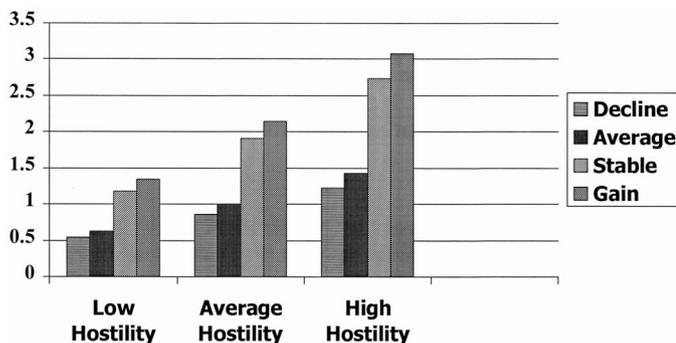
Fig. 1. Odds of Perceptions of inadequate social support at age 43 by change in hostility from college to midlife by levels of college hostility.
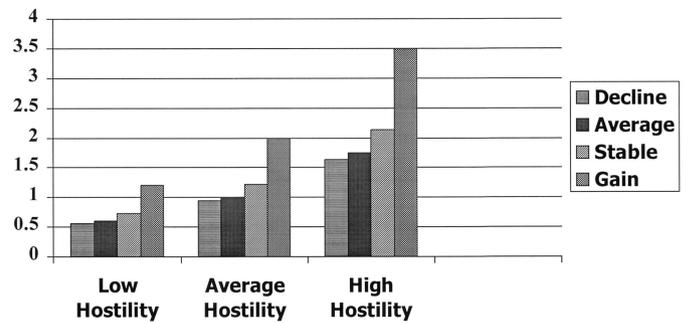
Fig. 2. Odds of Risk for Depression at age 47 by change in hostility from college to midlife by level of college hostility.

hostility was uniformly risky and doubled the risk for obesity, inadequate social support and depression, and reduced achievements. As shown in the figures, the impact of the pattern of change is similar across the levels of college hostility. For lower social support, stable and gain patterns are much riskier than average and decline patterns, whereas for depression, it is gain that is particularly risky. These findings for patterns of change add to our understanding of the potential for hostility to do harm by increasing factors that are associated with increased risk of chronic disease outcomes.

The present findings also demonstrate that hostility assessed during the late teens predicts unhealthy behaviors and negative appraisals up to 30 years later. Specifically, higher levels of hostility during college age were associated with increased likelihood of smoking, drinking more than recommended, perceptions of inadequate social support, evaluations of achievements as worse than expected, higher levels of depressive symptoms, and reporting life changing for the worse in family life experienced during midlife. Having higher than average hostility is risky; however, having lower than average hostility is not protective. This clustering of associations suggests that high hostility in college may be associated with important pre-disease pathways (4).

More proximally, change in hostility measured from college to age 41 continued to predict those factors and, in addition, it predicted obesity, avoidance of exercise, a high-fat diet, relative social isolation, negative appraisals of changes in economic circumstances, work life, and physical health over the next 10 years; and for women, relatively lower income. Only smoking and drinking were not predicted in the residualized change analysis. When college hostility and change in hostility are considered in the same model, the effect of college hostility is strengthened such that all of the indicators are significantly predicted by college hostility.

The only significant gender interaction with change in hostility was for family income. The percent of the sample in the lower income category (5% of men and 8% of women) was small overall. Other work on income with the UNCAHS did not find gender interactions (58). The overall lack of gender interactions elsewhere in this sample may be due to the fact that the UNCAHS sample was formed from men and women who attended the same university at the same time,

TABLE 5. College hostility and risk: continuous and categorical models adjusted for gender and change in hostility

Risk Indicators	College Hostility: Continuous Model	Low vs. Average Category	High vs. Average Category
Current smoker	**1.36 (1.12–1.65)**	0.77	**1.43**
Obese	**1.38 (1.14–1.68)**	**0.69**	**1.24**
Avoid exercise	**1.41 (1.03–1.93)**	0.66	1.09
High-fat diet	**1.24 (1.06–1.45)**	0.66	1.01
Excess alcohol	**1.20 (1.03–1.39)**	0.68	1.25
Socially isolated	**1.34 (1.06–1.68)**	0.87	1.47
Inadequate social support	**1.18 (1.03–1.34)**	0.55	**1.54**
Achieved < median income	**1.37 (1.07–1.74)**	0.86	**1.60**
Achieved < in career	**1.56 (1.37–1.79)**	0.76	**1.46**
Achieved < in relationships	**1.58 (1.39–1.79)**	0.68	**1.49**
Risk for depression	1.92 (1.59–2.30)	0.57	**1.72**
Family life changing for worse	**1.44 (1.18–1.75)**	0.67	**1.46**
Work life changing for worse	**1.32 (1.11–1.56)**	0.78	**1.50**
Economic life for worse	**1.39 (1.11–1.73)**	0.57	1.15
Physical health for worse	**1.38 (1.17–1.64)**	**0.62**	**1.52**

Reference group for categorical models of college hostility was average hostility (12–21). Low hostility was < 12 and high hostility was >21.

thus potentially creating greater homogeneity between genders than is typically found in random sample studies.

These new findings on hostility's prediction of life changing for the worse adds to our findings on personality change during midlife from age 41 to age 50 (61). Measures of social support, distress, and life changing for the worse were strongly related to hostility at both time points. Smoking and excess alcohol consumption were significant for college but not residualized change in hostility. Rates of smoking (12%) are what would be expected for a cohort with this level of education. Continuing to smoke in 1994 to 1996 may be related to measures of addiction but we do not have data to confirm this. Recent findings from Denmark (64) suggest that there are differences in associations of alcohol consumption that vary by type of beverage. Wine drinking is associated with optimal psychosocial characteristics and beer drinking with suboptimal characteristics. In the UNCAHS, we found that wine drinkers had healthier habits (65). When hostility at midlife was the independent variable (analyses not shown), all risk categories were significantly predicted, and there were no gender interactions. Thus the findings in terms of smoking, excess alcohol use, and the gender interaction with income may also be related to the effect of controlling for college hostility. Significant contrasts seen in the models for midlife hostility uncontrolled for college hostility are shown in the footnotes to Table 4 and as our analyses from Table 5 show, the impact of college hostility is affected by patterns of change from college to midlife.

There are several limitations to the present paper. Hostility was assessed only at two points in time. We do not know the developmental course of this construct or when it reaches its final adult level. Rogosa (66) points out the limitations of a single repeated measure and residualized change analysis. With future measures, we will be able to assess individual growth curves. We do not have college measures on the full set of risk indicators or physiological risk indicators. This sample is of relatively high socioeconomic status and is pre-

dominately Caucasian; thus, these findings may not generalize to more diverse populations. It is reasonable to expect that our hostility-risk associations will hold true for other samples. The same risk factors appear to operate with disparate impacts (56). The sample is predominantly male, reducing our power to detect gender interactions. Both our measures of hostility were measured before age becomes a risk factor for CHD (age 45 in men and age 55 in women). These findings may be different when change is studied later in the life cycle and when this cohort develops enough cases of CHD and specific cancers that these relationships can be tested directly. However, recent findings by Raikkonen, Matthews, and Kuller (14) in middle-aged women tend to support our results. They show the prediction of hypertension by the trajectory of risk measured over 9 years of follow-up observation.

Our use of high-risk endpoints has both costs and benefits. For example, previous work has found that college hostility was related to BMI in this sample (23) while the present results that dichotomize BMI at 30, (which was also measured 7 years later), is only related to change in hostility. We also found that amount of exercise was significantly associated with hostility such that more hostile persons exercised more (23). Again, when the variable was measured later and defined as avoidance of exercise, it was predicted only by change in hostility. On the benefit side, the use of high-risk endpoints makes the hostility findings more similar to those found in the epidemiologic literature (39).

Levels of college hostility are important in the sense that lower levels may be protective and higher levels confer greater risk. However, patterns of change in hostility are also of importance. On average, in this sample, hostility declines about 4.5 points. Declines in hostility greater than this average amount confer reduced risk. Individuals who show nonnormative or atypical maturational trends of continuing increases in hostility are clearly discrepant from the typical pattern of personality changes found in measures of hostility or antagonism more broadly. Studies on American samples as well as a

variety of other cultures show this cross-cultural consistency of declines from adolescence to adulthood. Recent studies suggest that the declines, though small in magnitude, may continue along to the fifth or sixth decade (67–69).

Overall, during the decade of the 40s, the normative trend is to reduce mean levels of negative traits (66). The current findings indicate that those who do not, not only remain at risk for negative health consequences but compared with those who show declines in their levels of hostility, gainers experience increased risk of negative outcomes. McGinnis and Foege (5) found that unhealthy behaviors and environmental exposures were the "actual causes of death" in over 50% of all US mortality. Interventions designed to reduce (25) or (potentially more important) prevent gains in hostility, especially those delivered earlier in the lifecycle when they can exert a longer term impact, may well help to reduce health risk behaviors and thus enhance the health of the population. Hostility is not the only risk factor and it most certainly does not operate in isolation; however, it would not be a bad place to focus.

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