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Protective Factors in Adolescent Health Behavior

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The role of psychosocial protective factors in adolescent health-enhancing behaviors—healthy diet, regular exercise, adequate sleep, good dental hygiene, and seatbelt use—was investigated among 1,493 Hispanic, White, and Black high school students in a large, urban school district. Both proximal (health-related) and distal (conventionality-related) protective factors have significant positive relations with health-enhancing behavior and with the development of health-enhancing behavior. In addition, in cross-sectional analyses, protection was shown to moderate risk. Key proximal protective factors are value on health, perceived effects of health-compromising behavior, and parents who model health behavior. Key distal protective factors are positive orientation to school, friends who model conventional behavior, involvement in prosocial activities, and church attendance. The findings suggest the importance of individual differences on a dimension of conventionality-unconventionality. Strengthening both proximal and distal protective factors may help to promote healthful behaviors in adolescence.

Adolescence is a critical period for the adoption of behaviors relevant to health (Jessor, 1984; Maggs, Schulenberg, & Hurrelmann, 1997). Health-related habits, values, and lifestyles established during this important formative period "are likely to continue throughout life" (Maggs et al., 1997, p. 523) and, consequently, have enduring consequences for individual health and well-being. The early formation of healthy behavioral practices, such as eating foods lower in fat and cholesterol and engaging in regular physical exercise, not only has immediate benefits for health but contributes to the delay or prevention of major causes of premature disability and mortality in adulthood—heart disease, stroke, diabetes, and cancer (Adeyanju, 1990; Haskell, 1984; Matarazzo, 1984; Meredith & Dwyer, 1991; Sallis, 1993). A major task for the promotion of adolescent health is to advance understanding of the network of influences—the "web of causation" (MacMahon, Pugh, & Ipsen, 1960, p. 18)—that can account for variation in adolescent health-related behaviors.

In this article, we examine psychosocial influences on adolescents' health behaviors—a set of individual differences in personality characteristics, in perceived social environmental factors, and in other behaviors that may influence young people's engagement in actions that promote, maintain, or protect their health. We focus on the role that psychosocial protective factors play in adolescents' involvement in behaviors that can enhance their health, specifically, regular physical exercise, healthy eating habits, dental care, safety behavior, and adequate sleep.

The conceptual role of protective factors is to increase the likelihood of desirable or positive behaviors or outcomes in diverse life areas, including health and well-being, and also to buffer or moderate the negative influence of exposure to risk (Luthar, 1993; Rutter, 1987). Two categories of protective factors are examined in this article. The first category consists of those protective factors that are health-specific, that is, they are variables proximal to, and directly implicating, health. Such health-specific protective factors include personal orientation toward and commitment to health (e.g., value on health and internal health locus of control) and perceived social support for engaging in health behaviors (e.g., parental and peer models for health-enhancing behavior). The second category of protective factors consists of psychosocial variables that are distal from health, that is, variables that do not have any direct reference to health or any obvious or immediate implication for health-enhancing behavior. Nevertheless, they also can serve a protective function. The category of distal protective factors includes personality, perceived social environment, and behavior variables that reflect an orientation toward and involvement with the conventional institutions of family, school, and church (e.g., religiosity, positive relations with adults, and participation in prosocial activities such as family activities, school clubs, and volunteer work).

Linking the proximal protective factors to variation in health-enhancing behavior is unproblematic because their very content implicates their relationship. Linking the distal protective factors, however, requires theory because their content has no obvious relationship to health behavior. The guiding framework in this regard is problem-behavior theory (Jessor, Donovan, & Costa, 1991; Jessor & Jessor, 1977), a theoretical formulation specifically concerned with psychosocial instigators (risk factors) and controls (protective factors) that regulate the transgression of conventional norms. Over a decade ago, it was already argued that "the theory may well have relevance . . .

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for variation in health-enhancing behavior . . . to the extent that the latter can usefully be conceptualized as conventional'' (Jessor, 1984, p. 80). Because health-enhancing behaviors, such as healthy eating habits, regular exercise, adequate sleep, dental care, and safety practices, are advocated, encouraged, and supported by the various institutions of conventional society—the family, schools, and church—engagement in them can reflect adherence to the norms of conventional society. It is this formulation that engages the distal conventionality-related variables of problem-behavior theory, variables explicitly used to account for transgression of—or adherence to—conventional norms. In this regard, our own earlier research has indeed demonstrated that measures of psychosocial conventionality are positively correlated with health behaviors in adolescence (Donovan, Jessor, & Costa, 1991). The critical interest in the present study is to determine the influence of such distal protective factors, once proximal health protection has been taken into account. To our knowledge, the direct and moderating effects of proximal and distal protection on health-enhancing behavior have heretofore not been investigated. Establishing a wider network of psychosocial protective factors, beyond those obviously proximal to health, should have significant implications for approaches to adolescent health promotion.

In any investigation of protective processes, it is, of course, necessary to examine risk processes at the same time (Rutter, 1987). The present study incorporates a set of proximal risk factors that can compromise engaging in health-enhancing behavior. Risk factors are, conceptually, conditions or variables associated with a lower likelihood of positive or socially desirable outcomes and a higher likelihood of negative consequences. With respect to health behavior, risk factors operate, specifically, to reduce involvement in health-enhancing behavior or to encourage other behaviors that are incompatible with health-enhancing behaviors. The psychosocial risk factors examined in this study include individual differences in susceptibility to peer pressure, in perceived life stress, in peer models for sedentariness and for poor eating habits, and in parental models for cigarette use. The assessment of health-related risk factors permits not only an examination of their direct influence on health behavior but also an investigation of the buffering role of protective factors as moderators of the impact of risk. That is, their protective effect may be greater at high levels of risk than when risk is low.

Despite extensive research, understanding of the patterns of factors that influence adolescents' participation in health-enhancing behaviors is still quite limited (Weiss, Larsen, & Baker, 1996). There has been relatively little work on psychosocial variables associated with health practices in adolescence (Sussman, Dent, Stacy, Burton, & Flay, 1995). In a previous cross-sectional study, positive orientation to health and greater conventionality were both linked to greater involvement in a variety of health-enhancing behaviors (Donovan et al., 1991). Most other research has assessed only a few isolated variables, and most of those are highly proximal predictors of health behavior (Gillis, 1994; Gottlieb & Chen, 1985; Lonnquist, Weiss, & Larsen, 1992; Oleckno & Blacconiere, 1991; Rivas Torres & Fernandez Fernandez, 1995; Weiss et al., 1996). There is, for example, a positive relation between value on health, on the one hand, and safety practices such as seatbelt use (Rivas Torres & Fernandez Fernandez, 1995) as well as overall participation in health behaviors (Lonnquist et al., 1992; Weiss et al., 1996), on the other. Peer and parental models for health behavior have also emerged as significant correlates of young people's participation in health behaviors (Gillis, 1994; Gottlieb & Chen, 1985; Lonnquist et al., 1992; Weiss et al., 1996). Other, more distal correlates of health behavior include self-efficacy (Gillis, 1994) and religiosity (Oleckno & Blacconiere, 1991). These findings were derived from samples of college students and younger adolescents; samples were typically quite small (Gillis, 1994; Lonnquist et al., 1992; Rivas Torres & Fernandez Fernandez, 1995; Weiss et al., 1996) and consisted mostly of White youth (Donovan et al., 1991; Gillis, 1994) or of adolescents of unspecified racial–ethnic background (Lonnquist et al., 1992; Oleckno & Blacconiere, 1991; Weiss et al., 1996). In addition, there was wide variability in the criterion measures of health behavior that were used.

Social cognitive models of health-protective behavior have relied almost exclusively on proximal health-related cognitions to predict health behaviors. The most frequently used of these approaches (see Weinstein, 1993) include the health belief model (Becker, 1974), the theory of reasoned action (Fishbein & Ajzen, 1975), subjective expected utility theory (Edwards, 1954; Ronis, 1992), and protection motivation theory (Prentice-Dunn & Rogers, 1986). Beyond their reliance on proximal predictors, these models typically are concerned with particular health-related choices or decisions rather than with explaining the characteristic level of involvement in health behaviors. Among the contributions of the present research is the exploration of more distal protective factors that may have a regulatory impact on adolescent engagement in health-enhancing behaviors and of their role in accounting for the level of that engagement.

This focus on individual differences in psychosocial protective factors extends our earlier work on successful development among at-risk youth (Costa, Jessor, & Turbin, in press; Jessor, Turbin, & Costa, in press; Jessor, Van Den Bos, Vanderryn, Costa, & Turbin, 1995). Those studies examined patterns of psychosocial risk and protection related to variation in outcomes in the domains of school engagement and problem-behavior involvement. The concern of the present study is with a different domain, that of health-enhancing behavior in adolescence. We examine the direct effects of protective factors on levels of health-enhancing behavior, and we also assess the moderating influence of protection on exposure to risk. In addition, we assess whether psychosocial protective factors that are distal from health behavior have an independent relation to engagement in health-enhancing behavior or whether their relation is entirely mediated by the variables more proximal to health behavior. Both cross-sectional and longitudinal analyses of individual differences in risk and protective factors were carried out in a sample of racially and socioeconomically diverse male and female adolescents. Four key questions are addressed:

1. Do proximal, health-specific protective factors have a direct, positive relation with adolescent health-enhancing behavior?

2. Do distal protective factors, reflecting psychosocial conventionality, account for unique variation in health-enhancing

behavior that is not explained by proximal, health-related risk and protective factors?

3. Do proximal and distal protective factors moderate the relation of health-specific risk factors to adolescent health-enhancing behavior?

4. Do proximal and distal protective factors predict the development of health-enhancing behavior in adolescence?

Method

Study Design, Procedures, and Participants

The data reported in this article are from a longitudinal, questionnaire study of health-related behavior among adolescents in a large urban area in the Rocky Mountain region. The sample was drawn from six middle schools and four high schools selected to maximize minority racial–ethnic representation. Letters describing the study were written to the students and to their parents, and students returned signed consent forms to the schools. All letters and consent forms were written in both English and Spanish. Confidentiality was safeguarded by a certificate of confidentiality from the U.S. Department of Health and Human Services. Study participants were released from class to take part in large-group administration sessions. Bilingual versions of the questionnaire were available for those students who preferred to work in Spanish. Four annual waves of data were collected from Spring 1989 through Spring 1992. After the first wave, participants who could not be reached for participation at school were contacted by mail and asked to complete the questionnaire and send it back to the researchers. Each student received a token payment of $5 for participating in each wave.

Largely because of the necessity of obtaining active personal and parental consent, and because of the difficulty of eliciting a response from many of the parents, the initial participation rate was less than desirable. At Wave 1 (1989), 2,263 Hispanic, non-Hispanic White, and Black students in Grades 7 through 9 filled out questionnaires (67% of the seventh and eighth graders and 49% of the ninth graders). Comparisons of the Wave-1 participants with the nonparticipants, using school record data, showed that the participant sample represented the full range of scores on grade point average (GPA), standardized achievement test scores, and disciplinary actions, and nearly the full range on school absences, even though participants had, on average, higher academic achievement (average GPA 2.5 vs. 1.7, $t[3802] = 25.6$, $p \leq .001$; average composite test score 45 vs. 36, $t[2568] = 9.1$, $p \leq .001$) and fewer absences (average 18 vs. 33, $t[2339] = 19.3$, $p \leq .001$) and suspensions (average 0.4 vs. 0.7, $t[3544] = 7.0$, $p \leq .001$) than nonparticipants. Forty-two percent of the Wave-1 sample are Hispanic, 33% are non-Hispanic White, and 24% are Black; 55% are female.

The most comprehensive set of measures relevant to the purposes of this article is available only in Wave 3 (1991) and Wave 4 (1992). The Wave-3 questionnaire was completed by 1,863 (82%) of the Wave-1 participants, and the Wave-4 questionnaire was completed by 1,688 (75%) of the Wave-1 participants. The primary, cross-sectional analyses for this article are based on the data from Wave 4; data from other waves are used for replication. The analysis sample includes those Hispanic, White, and Black participants with complete Wave-4 data. In this sample, $n = 1{,}493$; 589 (40%) are Hispanic, 572 (38%) are non-Hispanic White, and 332 (22%) are Black; 57% are female; and about equal percentages were in Grades 10, 11, and 12 at Wave 4. Forty-four percent of the participants are from intact families; 17% have a stepparent living with them (usually a stepfather); 33% live with one parent, usually the mother, or alternate living with each parent; and 6% live with other relatives or guardians.

To gauge the possible biasing effect of subsequent attrition from the original Wave-1 participant sample, we compared the participants who have complete Wave-4 data with those who do not on the 16 Wave-1 measures of variables used in the present analyses. The 770 participants lost to attrition ($n = 575$) or missing data ($n = 195$) after Wave 1 reported, as expected, somewhat less health-enhancing behavior ($p \leq .05$), higher means ($p \leq .05$) on four out of five risk factors, and lower means ($p \leq .05$) on 4 out of 10 protective factors. The magnitudes of the differences, in standard deviation units, ranged from 0.01 to 0.20. Despite these mean differences, however, the intercorrelations between the measures are very similar in both groups. A test of the similarity of the covariance matrices of the two groups against a model that equated the covariances for each measure (see Jöreskog & Sörbom, 1989) yielded a goodness-of-fit index of .96. Although the chi-square is significant, $\chi^2(120, N = 400) = 159.9$, $p \leq .01$, it is small for the sample size and number of variables involved (much less than twice the 120 degrees of freedom), indicating a very good fit. Therefore, relations among the 16 measures would have been about the same if no cases had been lost to attrition or missing data. The results reported below, therefore, are not likely to have been biased by sample loss after Wave 1.

Establishing the Health-Enhancing Behavior Index

Health behaviors span a wide range of activities. Promoting good health involves actions in a variety of areas: eating a healthy diet, getting adequate sleep, engaging in regular exercise to maintain physical fitness, practicing good hygiene, and avoiding injury. To ensure a broad sample of health-enhancing behaviors, we employed measures of five categories of behavior: healthy diet, regular exercise, adequate sleep, good dental hygiene, and regular seatbelt use.

Healthy diet is a nine-item scale ($\alpha = .88$); questions begin with the phrase "Do you pay attention to . . ." and concern eating enough healthy foods and avoiding unhealthy foods. Some items are specific, such as "keeping down the amount of fat you eat" and "eating healthy snacks like fruit instead of candy," whereas other items are more general, such as "eating only as much as your body really needs" and "eating in a healthy way even when you're with friends." Response options are *none, some,* and *a lot. Regular exercise* was assessed by four items ($\alpha = .70$) asking how many hours each week are spent playing sports or engaging in other physical activities. The six response options range from *none* to *8 or more hours a week.* Within this range, more activity is assumed to be more health-enhancing. *Adequate sleep* was measured by averaging two indicators assessing number of hours of sleep ($\alpha = .80$). One asks, "How much sleep do you usually get each night?" The other is computed from two items, usual bedtime and usual time for getting up in the morning. Scores ranged from 5 to 10.5 hr. *Good dental hygiene* is a three-item scale ($\alpha = .57$) assessing frequencies of brushing teeth, flossing, and using anticavity rinse. The four response options vary from *almost never* to *after every meal. Seatbelt use* is a four-item scale ($\alpha = .93$) assessing frequency of using a seatbelt when driving alone and with a friend, and when riding with a friend and with a parent. The four response options range from *hardly ever* to *almost always.*

A single summary measure of health-enhancing behavior, a composite of the five measures described above, was constructed. The factor structure of the five measures was examined by principal-axis factoring using squared multiple correlations as communality estimates. One factor had an eigenvalue of 1.59, explaining 32% of the total variance, and the other four eigenvalues were grouped closely together between .67 and .99. This pattern is interpreted as showing one common factor. A similar finding of a single common factor emerged earlier from the Wave-1 data that included middle-school and high-school students ($N = 3{,}499$; Donovan, Jessor, & Costa, 1993). The largest factor loading was for healthy diet (.71). Dental hygiene and regular exercise had moderate loadings (.36 and .35, respectively). Seatbelt use and adequate sleep had fairly small loadings (.26 and .23). Because much of the variance in these health behavior measures is not shared by the common factor, a composite measure should be considered an index of five different domains of health-enhancing behavior rather than a scale.

The criterion measure for the present analyses is this composite health-enhancing behavior index (HEBI), computed as the mean of the z scores of the five measures described above. There were some small but significant sociodemographic differences in average scores on the HEBI as follows. Socioeconomic status (SES), measured by father's occupation and father's and mother's education, correlated .14 ($p \leq .001$) with the HEBI; higher status is associated with more health-enhancing behavior. Male participants had a slightly higher mean score on the HEBI than female participants ($r = -.05$, $p \leq .05$). Grade cohort correlated −.08 ($p \leq .001$) with the HEBI, showing less health-enhancing behavior for the older participants. Participants who lived with both biological parents throughout the four waves of the study reported slightly more health-enhancing behavior than those from nonintact families (0 or 1 dummy variable; $r = .06$, $p \leq .05$). White participants reported more health-enhancing behavior than non-White participants (0 or 1 dummy variable; $r = .09$, $p \leq .001$). There was no significant difference on the second ethnicity measure, which contrasted Hispanic with Black participants.

The Measurement of Psychosocial Risk Factors and Protective Factors

For the present study, our interest is in those characteristics of adolescents and their perceived social environment that may operate as risk factors or protective factors for engagement in health-enhancing behavior. Attitudes, values, and perceptions that directly refer to health—proximal variables—are, of course, expected to relate to health behavior itself. We are more interested, however, in exploring whether attributes that do not refer to health—distal variables—also relate to engagement in health-enhancing behavior. Therefore, measures of psychosocial protective factors distal from health behavior were examined as well.

Health-related risk factors. Five health-related risk factors were measured. Three of the risk factors measure the prevalence of models for involvement in health-compromising behaviors, behaviors antithetical to health enhancement. *Friends as models for sedentary behavior* is a single item: "Do your friends usually sit around a lot instead of getting some exercise or working out?" *Friends as models for eating junk food* is also a single item: "How many of your friends eat a lot of 'junk food' instead of a healthy diet?" Both items had 4-point response scales ranging from *None of them do* to *All of them do.* Another single-item measure, *parents smoke cigarettes,* asked whether father, mother, or both parents smoke (coded 0, 1, or 2 parents who smoke). Exposure to friends or parents who model health-compromising behaviors constitutes risk because models indicate that those behaviors are acceptable and, consequently, may promote orientations and social networks incompatible with health-enhancing behaviors. Furthermore, prevalence of these models indicates that health-compromising behavior is characteristic of or normative in the social group in which the adolescent is included. A fourth risk factor, *felt stress,* was assessed by three items ($\alpha = .72$) that asked, "In the past six months, how much stress or pressure have you felt at school," "at home," and "in your personal or social life?"[1] High levels of stress are presumed to discourage or interfere with the maintenance of health and may instigate coping behaviors (e.g., substance use) that are incompatible with health maintenance. Fifth, *susceptibility to peer pressure* was included as a risk factor because the influence of peers, and of pressure to go along with the crowd, is often in a health-compromising direction. High susceptibility, or a low level of refusal skills, may leave the adolescent vulnerable to engagement in behaviors incompatible with maintaining health. This risk factor was measured by a single item: "How well do you resist peer pressure from the rest of the group?" The item was reverse-scored to make higher scores represent greater risk.

Health-related (proximal) protective factors. Five proximal health-related measures were used as protective factors. *Value on health* is measured by 10 items ($\alpha = .87$) that ask how important various health outcomes are to the respondent, such as "to feel in good shape" and "to get better quickly when you are sick." A positive value on health constitutes protection because it indicates the personal importance attached to health and represents a commitment to behaviors that promote healthful outcomes. *Perceived health effects* is measured by six items ($\alpha = .76$) that ask how serious an effect behaviors like "getting less than 8 hours of sleep each night," "not exercising regularly," and "eating a lot of junk food" can have on the health of young people. Perception of strong negative outcomes should serve to deter engaging in such behaviors. *Internal locus of control for health* consists of four items ($\alpha = .63$) that ask for degree of agreement or disagreement with statements indicating that one's own behavior can promote staying healthy (e.g., "I might get sick more often if I didn't take care of myself"). An internal locus of control is protective because it indicates that engaging in health-enhancing behaviors is within one's control and that such behaviors can be instrumental for achieving valued health outcomes. The remaining proximal protective factors measure models for involvement in health-enhancing behaviors. *Parents as models for health behavior* (eight items; $\alpha = .80$) and *best friend model for health behavior* (four items; $\alpha = .63$) include items that ask how much attention is paid by mother, father, and best friend to "eating a healthy diet," "getting enough exercise," "getting enough sleep," and "using seat belts when in a car." Models for health-enhancing behaviors constitute protection because models provide opportunities to learn how to engage in the behaviors, provide social support for engaging in the behaviors, and indicate that the behaviors are characteristic of the social group to which the adolescent belongs.

Conventionality-related (distal) protective factors. As stated earlier, other aspects of adolescents and their environment, distal from health behavior, may also serve to regulate health behavior. Seven measures of psychosocial conventionality were examined as an additional set of protective factors for health-enhancing behavior. None of the items in these measures has any reference, directly or indirectly, to health. *Orientation to school* is a 13-item scale ($\alpha = .87$) measuring attitudes toward school (e.g., "How do you feel about going to school?") and personal value on academic achievement (e.g., "How important is it to you to get at least a B average this year?"). Having a positive orientation to school reflects positive engagement with a conventional social institution and commitment to its goals. Such an orientation toward conventionality is not compatible with engaging in behaviors that are considered inappropriate by adults and that may also jeopardize conventionally valued outcomes. *Religiosity* is a four-item scale (available only in Waves 3 and 4; $\alpha = .89$) measuring the importance of religious beliefs and teachings for the direction of daily life. Religiosity reflects a commitment to conventional values and disapproval of norm-violative activities and serves as a personal control against involvement in nonnormative behaviors. *Orientation to parents* is a two-component index based on standardized scores on two scales, one measuring perceived agreement on values between one's parents and friends (three items, e.g., "Would your friends agree with your parents about what is really important in life?"; $\alpha = .78$) and the other measuring the relative influence of parents and friends on the respondent's outlook, life choices, and behavior (three items, e.g., "If you had to make a serious decision about school, who would you depend on most for advice—your friends or your parents?"; $\alpha = .69$). Higher parents–friends agreement and higher influence from parents indicate greater orientation to parents and constitute conventionality because parents represent and exercise controls against norm-violative behavior and generally serve as models for conventional values,

[1] Wave-4 reliabilities are reported for all measures. In Wave 3, the reliability for each measure does not depart from the Wave-4 value by more than .03.

attitudes, and activities. *Positive relations with adults* was measured by four questions (α = .70) assessing a respondent's relationships with parents and other adults, including the extent to which parents show interest in the respondent and whether the respondent is able to discuss personal problems with an adult. More positive relations with adults indicates greater conventionality because adults generally provide support for conventional behavior and sanctions against normative transgression. *Friends as models for conventional behavior,* a six-item scale (α = .78), assesses the proportion of friends who get good grades in school and who engage in conventional activities such as school clubs, community and church groups, and family activities. This measure reflects greater involvement with conventional peers engaged in conventional activities. *Prosocial activities* is a three-item index that combines own involvement and time spent in family activities, in volunteer activities, and in school clubs other than sports (α = .39). *Church attendance* is a single item (available only in Waves 3 and 4) assessing frequency of going to religious services during the past 6 months. Higher levels of prosocial activities and of church attendance reflect higher involvement with conventional institutions, promote orientations and social networks incompatible with unconventional behavior, and also preempt time to become involved in the latter.

Because all of the measures are based on self-report, establishing discriminant validity between predictors and the criterion is important for valid interpretation of findings. Therefore, prior to carrying out the main analyses, we examined the discriminant validity between the criterion measure, the HEBI, and the predictor most similar to it in the number and content of its components, the measure of best friend model for health behavior. The correlation between these 2 measures is .36; they share only 13% of their variance. The correlations of these 2 measures with 10 other measures of the participant's health-related and conventionality-related values, beliefs, and behaviors were then compared. The magnitude of these correlations ranged from −.02 between best friend model for health and stress to .34 between the HEBI and orientation to school. In each case, the measure of own behavior, the HEBI, correlated more strongly with the 3rd measure than did the measure of best friend model; 8 of the 10 differences between the pairs of correlations, differences ranging from .06 to .16, are significant ($p \leq .05$). These findings support the discriminant validity of the measure of participant's own health behavior as against perceived best friend's health behavior and suggest that the multivariate relations to be examined are not merely the result of the confounding of two self-reports.

Another avenue for demonstrating discriminant validity between a measure of the participant's own health-enhancing behavior and a measure of perceived friend's health behavior is to use them both to predict a third variable, while showing that each measure accounts for unique variance in the third variable. In multiple regressions predicting friends' problem behaviors and friends' conventional behaviors, and participants' problem behaviors and their prosocial activities (i.e., conventional behaviors), the HEBI measure and the best friend model for health behavior measure each contributed significant unique variance to each criterion measure. This is an additional demonstration that the two measures are not measures of the same thing.

The analytic procedure used in the present study is hierarchical multiple regression. At each step of the regression, we show the contribution of the measure(s) entered at that step, controlling for all measures entered before that step. This procedure enables us to demonstrate how much variance in health behavior is accounted for, in turn, by the health-related risk factors, the health-related protective factors, and the conventionality-related protective factors. At each step, the change in R^2 indicates whether the set of explanatory variables entered accounts for unique variation in health behavior (i.e., whether error variance is significantly reduced when those measures are included). The logic of this analytic approach is that it permits an assessment of whether distal conventionality measures, which have no obvious content-based relationship to the criterion, can nevertheless account for variation in health behavior beyond that already accounted for by the proximal, health-related measures.

This procedure also enables us to determine whether protection moderates the impact of risk. Including a risk by protection interaction term at a later step in the regression and examining whether that product adds predictability to the additive model is the accepted way to demonstrate a moderator effect (Aiken & West, 1991; Baron & Kenny, 1986; Cohen & Cohen, 1983; Saunders, 1956). Hierarchical multiple regression also permits sociodemographic effects to be partialed out in the first step, before the theoretical measures are entered. Because all predictors are mean-deviated (except parents smoke cigarettes, which has a meaningful zero point at its mode), the model describes relations at typical values of the predictors.

Results

Analyses presented in this section pertain to four main issues. We examine whether the various predictor sets—proximal risk factors, proximal protective factors, and distal protective factors—can account for variation in the HEBI. We also examine whether proximal and distal protection moderates the relation of risk to the HEBI. Next, we explore the robustness of those findings through replication in Wave 3 and near-replication in Waves 1 and 2 and also in an entirely independent sample. Finally, in longitudinal analyses of antecedent risk and protective factors, we examine the predictability of the Wave-4 HEBI criterion over time and development.

Relations of Health-Related Risk and Protective Factors to Variation in Health-Enhancing Behavior

The Wave-4 composite index of health-enhancing behaviors (the HEBI) is the criterion measure in a hierarchical multiple regression analysis. The theoretically derived predictors are the sets of proximal risk factors and proximal and distal protective factors described earlier. Table 1 shows that significant proportions of variance in health-enhancing behavior are indeed accounted for by health-related risk and health-related protective factors (see ΔR^2 column at Steps 2 and 3). In addition, and of key conceptual importance, the distal conventionality protection measures also account for significant variance (Step 5), even after the sociodemographic controls and the proximal risk and protective factors have been entered. That the three types of measures each provide significant improvement in the model attests to the fact that they are, at least to some extent, empirically as well as conceptually distinct. The final-step regression weight (B) for each measure in Table 1 shows its relation to the HEBI criterion, controlling for all other measures in the model.

The bivariate correlations in Table 1 show that five of the six sociodemographic measures—gender, White/non-White, grade in school, intact family, and SES—have small but significant correlations ($p \leq .05$) with the HEBI (described previously in the Method section). These effects were partialed out by entering the set of sociodemographic controls at Step 1 of the hierarchical regression where, together, they accounted for a small (3%, as shown in the ΔR^2 column) but significant ($p \leq .001$) proportion of variance.

Table 1
Hierarchical Regression of the Health-Enhancing Behavior Index (HEBI) on the Proximal Risk Factors and the Proximal and Distal Protective Factors, Wave 4 (1992, Grades 10–12)

Step	Measures entered	r	sr^2	B, final step	ΔR^2
1	Sociodemographic controls				.031***
	Gender	−.05*		−.055*	
	White/non-White	.09***		.052	
	Hispanic–Black	.00		.008	
	Grade in school	−.08***		−.062***	
	Intact family	.06*		−.030	
	Socioeconomic status	.14***		−.010	
2	Health-related risk factors				.120***
	Felt stress	−.20***	.037***	−.024***	
	Susceptibility to peer pressure	−.15***	.023***	−.025	
	Friends as models for sedentary behavior	−.24***	.049***	−.030	
	Friends as models for eating junk food	−.27***	.066***	−.058***	
	Parents smoke cigarettes	−.08***	.001	.033*	
3	Health-related protective factors				.197***
	Value on health	.34***	.078***	.024***	
	Perceived health effects	.28***	.059***	.016***	
	Internal locus of control for health	.28***	.039***	.009	
	Parents as models for health behavior	.44***	.115***	.032***	
	Best friend model for health behavior	.36***	.066***	.002	
4	Health-Related Risk × Health-Related Protection				.009***
	Parents Smoke Cigarettes × Best Friend Model for Health Behavior	.32***		.029***	
5	Conventionality-related protective factors				.059***
	Orientation to school	.34***	.011***	.005*	
	Religiosity	.08***	.002*	−.007	
	Orientation to parents	.25***	.005***	−.015	
	Positive relations with adults	.27***	.002*	.002	
	Friends as models for conventional behavior	.40***	.044***	.031***	
	Prosocial activities	.29***	.028***	.030***	
	Church attendance	.15***	.009***	.017**	
6	Health-Related Risk × Conventionality Protection				.004**
	Parents Smoke Cigarettes × Orientation to Parents	.21***		.032**	
Total R^2 = .42***					

Note. N = 1,493. sr^2 was calculated with all measures from preceding steps partialed out of the predictor. Standardized coefficients are not given because they are inappropriate with interaction terms (see Aiken & West, 1991, pp. 40–47). In Steps 4 and 6, interaction terms were included by stepwise selection ($p < .002$ at Step 4, $p < .0014$ at Step 6).
* $p \le .05$. ** $p \le .01$. *** $p \le .001$.

All five proximal health-related risk factors are negatively correlated with the health behavior criterion, as expected, and all of these correlations, although modest, are significant ($p \le .001$). When they were entered at Step 2, after the sociodemographic measures, they accounted for an increment of 12% of variance ($p \le .001$). Squared semipartial correlations are also shown in Table 1. With sociodemographic measures partialed out, the squared semipartial correlation between each health-related risk factor and the HEBI criterion is equal to the change in R^2 that would result if that particular risk factor were entered by itself at Step 2 of the regression—it is the increment in variance that could be accounted for by that one factor. Four of the five risk factors account for a significant increment in variance ($p \le .001$), as can be seen in the column for sr^2. Those same four risk factors have significant ($p < .001$) B coefficients at this step (not tabled); each one accounts for some variance not redundant with the other risk factors. In addition, two of those risk factors account for some unique variance in the HEBI: Felt stress and friends as models for eating junk food have significant negative B coefficients ($p \le .001$) in the final model shown in Table 1. Parents smoke cigarettes is also significant ($p \le .05$) as a suppressor variable, serving to improve the predictiveness of one or more other measures by partialing out variance not related to the HEBI.

As Table 1 also shows, all five of the proximal health-related protective factors have significant positive correlations ($p \leq .001$) with health-enhancing behavior as expected. These protective factors were entered at Step 3, after the sociodemographic controls and the health-related risk measures, to test whether they account for significant variance in the HEBI that is not accounted for by the risk measures. As shown by the change in R^2, they account for a large additional increment of 19.7% of variance ($p \leq .001$). That each health-related protective factor alone could account for variance in health behavior that is not related to the risk factors is shown by the significant ($p < .001$) squared semipartial correlations between the proximal health-related protective factors and the HEBI. In addition, all five of the health-related protective factors have significant ($p < .05$) regression weights at this step (not tabled), accounting for variance not shared by other health-related risk or protective factors. Three of them—value on health, perceived health effects, and parents as models for health behavior—also have significant B weights ($p \leq .001$) in the final model shown in Table 1.

Health-Related Protective Factors as Moderators of Risk

On the basis of theory and previous research (Jessor et al., in press; Jessor et al., 1995), we expected that protective factors can serve to moderate the effect of risk factors. That is, the relation of risk to health behavior should be attenuated when protection is high in contrast to when protection is low. A significant risk by protection interaction would provide evidence for such a moderator effect. Because there was no a priori basis for expecting any of these interactions to be nonsignificant (theoretically, all of them may interact), all 25 possible health-related risk by protection product terms were examined at Step 4 to see if any of these interactions make a significant contribution to explained variance (a significant increment in R^2) and, therefore, should be included in the model at this step. Probability of a Type I error was controlled by a Bonferroni adjustment, testing the B weight for each interaction term by a one-tailed t test with $\alpha = .05/25 = .002$, which keeps the overall alpha for this step at less than .05 (Judd & McClelland, 1989, p. 225). Any significant interaction term is included in the model at the step at which it is tested.

One significant interaction, that between parents smoke cigarettes and best friend model for health behavior, was entered at this step; this interaction accounted for a significant increment of almost 1% of variance ($p \leq .001$). The interaction shows that the relation of parents smoking to health behavior changes across different levels of best friend model for health behavior. More specifically, parents smoking is a significant risk factor (the more the parental models for smoking, the less the health-enhancing behavior) only at very low levels of best friend model for health behavior. Higher levels of that protective factor buffer that risk factor, so that at average and higher levels of best friend model, parents smoke has a positive coefficient, significant only as a suppressor variable.[2]

Relations of Conventionality-Related Protective Factors to Variation in Health-Enhancing Behavior

The seven distal conventionality protective factors were entered at Step 5 to test whether they account for additional variance in the HEBI, variance that is not accounted for by any of the health-related risk or protective factors already entered. With 36% of the variance already accounted for, they nevertheless accounted for a significant increment of nearly 6% of variance ($p \leq .001$) as shown in Table 1. All seven of these distal measures have significant positive correlations with the HEBI ($p \leq .001$). Even though the bivariate correlations are of similar magnitude to those for the preceding health-related proximal measures, the squared semipartial correlations are generally smaller, reflecting some redundancy between the proximal health-related measures and the distal conventionality measures. Nonetheless, as shown in Table 1, each of the seven could account for significant additional variance if entered alone at this step, and four of them have significant ($p \leq .05$) B weights and account for unique variance, both at this step (not tabled) and in the final model: orientation to school, friends as models for conventional behavior, prosocial activities, and church attendance. These are key findings for enlarging the network of psychosocial correlates of adolescent health behavior.

After the conventionality protective factors were included in the model, the 35 possible interaction terms with the health-related risk measures were tested at Step 6, with a Bonferroni adjustment to the alpha level ($\alpha = .05/35 = .0014$) to keep the overall alpha for this step at less than .05. One significant interaction entered the model at this step: The effect of parents smoking is moderated by orientation to parents, in the same way that it was moderated by best friend model for health behavior at Step 4.[3] Thus, parents smoking is a significant risk factor for health behavior only when protection from either of these two moderators—one proximal, one distal—is quite low.

The Generality of the Model

The generalizability of the regression model across genders, ethnic groups, grade cohorts, family structures, and SES levels

[2] The positive regression weight in Table 1 for parents smoke cigarettes (applicable at the average level of all other predictors) does not represent a positive association between parents smoking and health behavior. Rather, parents smoking is a suppressor variable. Only when the best friend model score is less than -2.2 ($M = 0$, $SD = 2$) does parents smoking have a significant negative coefficient, consistent with the sign of its bivariate correlation. At higher levels of best friend model, the suppressor effect can be seen by comparing the (positive) conditional slopes for parents smoking with its bivariate correlations. The bivariate correlation between parents smoking and the HEBI among participants with the highest scores on best friend model is .03 (*ns*); among those with scores near the mean, the correlation is $-.05$ (*ns*); among those with the lowest scores on best friend model, the correlation is $-.18$ ($p \leq .001$). Furthermore, the squared semipartial correlation for parents smoke is essentially zero; its variance is unrelated to the criterion measure.

[3] Parents smoke cigarettes has a significant negative coefficient for very low values of orientation to parents (values less than -2; $M = 0$, $SD = 1.5$). At higher values, parents smoke has a positive coefficient, serving as a suppressor variable.

was examined by testing for significant interactions between the sociodemographic measures, on the one hand, and the risk and protective factors (including the two significant risk by protection interactions), on the other. Significant interactions would indicate differences in the strength of predictors across those subgroups. None of the 114 sociodemographic interactions, tested with alpha set at .001,[4] is significant; the model does not differ significantly across the sociodemographic groups in this sample. The adequacy of the model across the full range of the HEBI was also tested by examining a plot of residuals against predicted values of the criterion, which showed no relation between the size of the errors and the value of the HEBI; the model fits equally well at all levels of the HEBI.

The Overall Explanatory Account

The total R^2 of .42 indicates that 42% of the variance in the HEBI criterion is accounted for by the six sociodemographic control measures, the five proximal health-related risk factors, the five proximal health-related protective factors, the seven distal conventionality protective factors, and the two risk by protection interactions. This constitutes a substantial account of variation in health-enhancing behavior in adolescence. Each health-related risk and protective factor has a significant bivariate correlation with the criterion, and nine of them have significant regression weights in the final multivariate model (not including parents smoke cigarettes, which is a suppressor). The risk by protection interactions show that two additional protective factors, best friend model for health behavior and orientation to parents, are significant for participants whose parents smoke cigarettes.

The increment of variance accounted for by each set of predictors depends, of course, on which predictors have already been entered into the hierarchical regression. By varying the order of entry, we were able to establish the unique variance in the HEBI accounted for by each set of predictors, when entered after all the other sets of risk and protective factors. Results show that the health-related risk factors account uniquely for 2% of variance; the health-related protective factors account uniquely for 10% of variance. As noted earlier and shown in Table 1, the conventionality-related protective factors account uniquely for 6% of variance. These results show that, despite substantial redundancy among the three sets of predictors in the criterion variance they account for, each set accounts uniquely for some variance in health-enhancing behavior. The results also show that, for these measures and this criterion of health-enhancing behavior, the protective factors—both those that are proximal and those that are distal—are more strongly related to the HEBI than are the risk factors.

Testing for Interactions Using Composite Risk and Protection Scale Scores

Although 2 out of 60 risk by protection interactions were found to be statistically significant in the previous analyses, their substantive significance may be considered problematic because so many significance tests were examined. In order to address this problem, we carried out a different kind of analysis in which each set of risk and protective factors was represented by a single scale score, computed as the mean of standard scores of the separate measures. Thus, a composite health-related risk scale and a composite health-related protection scale were entered at Steps 2 and 3 of the regression, followed at Step 4 by a test of the significance of the single interaction between the two scales. Then a composite conventionality-related protection scale was entered at Step 5, and its single interaction with the health-related risk scale was tested at Step 6 (not tabled; table available from the authors).[5] The former interaction term, at Step 4, is not significant ($p > .05$), whereas the latter interaction term, at Step 6, is significant ($p \leq .01$) and adds 0.3% of variance. Thus, a composite measure of health-related risk factors is shown to be moderated by a composite measure of conventionality-related protective factors. At low to moderate levels of protection, the risk scale is inversely related to the HEBI, and the higher the protection, the weaker the relation. When protection is very high, risk is not related to the HEBI. Conversely, when risk is very low, the effect of protection is weaker but still significant. This supplementary analysis, without the problem of having to carry out multiple significance tests, provides additional support for the key proposition that protective factors—in this case conventionality-related ones—moderate health-related risk factors. The convergence of these two different analytic approaches to assessing moderator effects enhances conviction that protection can moderate risk.

Replication of the Wave-4 Regression Analysis in Earlier Waves of the Study and Also in an Independent Sample

The four-wave design of our study allows us to examine whether the relations of risk and protective factors with health behavior shown in Table 1 hold in the preceding three waves of data. The same measures used in the Wave-4 analysis were available from most of the same participants in Wave 3. Most of the same measures, or reasonable approximations of them where certain items were not assessed, were also available in Waves 1 and 2. The analysis carried out for Table 1 was repeated, therefore, for Waves 1, 2, and 3, with as comparable as possible criterion measures and risk and protective factors computed from each wave of data.

In the three separate replications (not tabled; table available from the authors), total variance accounted for is between 41% and 44%, almost identical to that obtained in Wave 4 (42%). Further, at each step of the hierarchical regression, the proportion of variance accounted for by each set of predictors is also very nearly the same. At Step 2, the risk factors account for

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[4] This provides an overall alpha for this step of .11, but with statistical power of only about .50. Further reduction in alpha, with consequent further reduction of power, was deemed undesirable.

[5] The correlation between the health-related risk and health-related protection scales is −.34; between the health-related risk and conventionality-related protection scales, it is −.30; between the two protection scales, it is .44. The most strongly correlated pair of scales shares just 19% of their variance. The correlations of the health risk scale, the health protection scale, and the conventionality protection scale, respectively, with the HEBI are −.33, .53, and .42. Each scale accounts for significant ($p \leq .001$) variance in the HEBI; total R^2 is .37.

between 9% and 15% of variance. At Step 3, the health-related protective factors account for between 19% and 24% of variance. And at Step 5, the conventionality-related protective factors account for between 3% and 6% of variance.

Each risk or protective factor that is significantly related to the HEBI in the Wave-4 analysis is also significant in all three replications, with only three exceptions: In Wave 1, a single-item measure of stress is marginally significant (p = .07); church attendance, which was not available in Waves 1 and 2, has a probability value of .09 in the final model for Wave 3; and parents smoke cigarettes is not significant in any replication. Among the health-related risk or protective factors not significant in Wave 4, each is significant in two or three of the replications. The three conventionality-related protective factors that are not significant in Wave 4 are not significant in any replication, except susceptibility to peer pressure in Wave 1.

One of the three replications provides support for the hypothesized moderator effects. In Wave 1, positive relations with adults moderates the effect of friends as models for eating junk food. That risk factor is strongest at the lowest level of the protective factor and is nonsignificant for very high values of the protective factor. Or, conversely, positive relations with adults is a significant protective factor only for fairly high values of friends as models for eating junk food. Overall, then, the findings in Table 1 are shown to hold fairly consistently across developmental change as participants grew older (from ages 12–15 in Wave 1 to ages 15–18 in Wave 4) and across whatever historical changes took place over those same years.

An opportunity for replication of the analysis on an entirely independent sample was also available. Data had been collected in 1989 from a cross-sectional sample of 1,380 students in Grades 10–12 from the same high schools, using the Wave-1 questionnaire. Those students were tested only that once and not followed up, because they were already in high school. The analysis carried out for Table 1 was repeated using this sample (not tabled; table available from the authors). Health-related risk factors, in this sample, account for a significant ($p \leq .001$) 6% of variance; health-related protective factors, entered next, account for 17% of variance ($p \leq .001$); and conventionality-related protective factors account for an additional 2% of variance ($p \leq .001$). In the final model, felt stress and friends as models for eating junk food are significant risk factors, all five health-related protective factors are significant, and friends as models for conventional behavior and prosocial activities are significant conventionality-related protective factors. Also, risk is significantly moderated by protection in this sample: Friends as models for eating junk food is moderated by friends as models for conventional behavior ($p \leq .001$; risk has a stronger effect when protection is low, no effect when protection is high). Compared with the findings in Table 1 on the Wave-4 sample of 10th to 12th graders, somewhat less variance is accounted for in this sample by each set of predictors, and the overall R^2 of .33 is lower. In this regard, it should be noted that the data from this independent sample include a smaller number of predictor measures (15 vs. 17) and were obtained from the initial exposure to the questionnaire in a sample that had not been depleted by attrition. Overall, this replication on an independent sample provides additional support for the findings presented in Table 1.

Relations of Antecedent Risk and Protection With Developmental Change in Health-Enhancing Behavior

With the role of psychosocial risk and protection established in cross-sectional analyses of health-enhancing behavior, we turn to demonstrating their importance in accounting for the development of health behavior over time. For these analyses, we used the Wave-3 measures of risk and protection to predict the Wave-4 HEBI, controlling for the Wave-3 HEBI at Step 1 of a hierarchical multiple regression. Thus, we examined the predictability of change in HEBI, that is, the residual variance after Step 1 over a 1-year interval. In that interval, each component health behavior measure except seatbelt use showed a small but significant ($p < .001$) average decrease of 0.1 to 0.2 *SD* of the Wave-3 measures. Seatbelt use showed a small average increase of 0.06 *SD* of the Wave-3 measure ($p < .01$). Regression results are presented in Table 2.

The correlation between the Wave-3 and the Wave-4 HEBI is .70 (r^2 = .492), indicating substantial over-time stability. Bivariate correlations of the antecedent Wave-3 risk and protective factors with the Wave-4 HEBI are very similar to their concurrent, Wave-4 correlations presented earlier in Table 1. Again, sociodemographic effects, which are slight, were partialed out at Step 2 before the Wave-3 theoretical predictors were entered. The health-related risk factors, entered at Step 3, account for a significant ($p \leq .001$) 0.8% of variance, which is equivalent to about 2% of the residual variance. The squared semipartial correlations in Table 2 show that felt stress and susceptibility to peer pressure are significantly related to developmental change in health behavior after the sociodemographic measures were partialed out. Felt stress also has a significant B weight at this step, controlling for other risk factors. In the final model, greater felt stress is related to less health-enhancing behavior, over and above the effects of all other measures (B = −.015).

The health-related protective factors, entered at Step 4, accounted for another 0.6% of variance ($p \leq .01$), which is about 1% of the residual variance. Three of these protective factors—value on health, internal health locus of control, and parents as models for health behavior—have significant squared semipartial correlations with change in health behavior. Value on health also has a significant B weight at this step, controlling for all other health-related risk and protective factors. In the final model, after controlling for all other measures, greater value on health is related to more health-enhancing behavior (B = .008). All 25 possible interactions between the health-related risk and protective factors were examined for moderator effects; none reached significance at the .002 alpha level.

At Step 5, the conventionality-related protective factors accounted for another increment of close to 1% of variance ($p \leq .001$), which is 2% of the variance in change in HEBI. Four of these distal protective factors—orientation to school, positive relations with adults, friends as models for conventional behavior, and prosocial activities—could account for significant variance in change in HEBI that is not accounted for by the proximal risk and protective factors. Of those four, friends as models for conventional behavior and prosocial activities also have significant B coefficients at this step and in the final model. No interaction between the conventionality-related protective factors and

Table 2
Hierarchical Regression of the Wave-4 Health-Enhancing Behavior Index (HEBI) on Wave-3 Proximal Risk Factors and Proximal and Distal Protective Factors, Controlling for Wave-3 HEBI

Step	Measures entered	r	sr^2	B, final step	ΔR^2
1	Wave-3 HEBI	.70***		.584***	.492***
2	Sociodemographic controls				.006**
	Gender	−.05*		−.003	
	White/non-White	.09***		.042	
	Hispanic–Black	−.01		.014	
	Grade in school	−.11***		−.032*	
	Intact family	.06*		.003	
	Socioeconomic status	.16***		.010	
3	Wave-3 health-related risk factors				.008***
	Felt stress	−.21***	.006***	−.015**	
	Susceptibility to peer pressure	−.15***	.002*	−.008	
	Friends as models for sedentary behavior	−.18***	.000	.021	
	Friends as models for eating junk food	−.23***	.000	.001	
	Parents smoke cigarettes	−.07**	.001	.027	
4	Wave-3 health-related protective factors				.006**
	Value on health	.30***	.003**	.008*	
	Perceived health effects	.24***	.001	−.003	
	Internal locus of control for health	.28***	.002*	.006	
	Parents as models for health behavior	.40***	.002*	.003	
	Best friend model for health behavior	.29***	.001	.003	
5	Wave-3 conventionality-related protective factors				.009***
	Orientation to school	.31***	.001*	.003	
	Religiosity	.04	.000	−.010	
	Orientation to parents	.23***	.001	.003	
	Positive relations with adults	.28***	.002*	.006	
	Friends as models for conventional behavior	.31***	.004***	.010*	
	Prosocial activities	.27***	.005***	.013*	
	Church attendance	.12***	.001	.008	
Total R^2 = .52					

Note. N = 1,399. sr^2 was calculated with all measures in preceding steps partialed out of the predictor.
* $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

the risk factors is significant at the .0014 alpha level; nor is any sociodemographic interaction significant at $p \leq .001$. All together, the Wave-3 risk and protective factors account for 4.5% of the variance in change in health behavior over a 1-year interval. The total R^2 is .52.

This longitudinal analysis was replicated for the longest time interval available in these data, the interval between Wave 1 and Wave 4 (not tabled; table available from the authors). The correlation between the Wave-1 and the Wave-4 HEBI is .52 (r^2 = .27). The increment in variance in change in HEBI accounted for by the Wave-1 risk and protective factors is 3.2% ($p \leq .001$), which is 4.4% of the residual variance. No health-related risk factor reaches significance in the final model, but friends as models for eating junk food is close (p = .08); two health-related protective factors are significant—value on health and internal locus of control for health; and two conventionality-related protective factors are significant—positive relations with adults and prosocial activities. There is no significant interaction between risk and protection at the .002 alpha level, nor is any sociodemographic interaction significant at $p \leq .001$. Total R^2 is .31.

These prospective analyses show that antecedent psychosocial risk and protection do predict, at least to some extent, the subsequent development of health-enhancing behavior. Although the proportion of variance accounted for in change in the HEBI is small, it is nevertheless significant and has theoretically important implications.

Discussion

The role of psychosocial protective factors in adolescent health-enhancing behavior, and in its development, are key findings of the present study. Protective factors account for substantial variance in health-enhancing behavior in adolescence, and, in this study and with these measures, they account for more unique variance (16%) than do the risk factor measures (2%).

There is also modest evidence that protection, in addition to its direct relation to health-enhancing behavior, may moderate the relation of risk to health-enhancing behavior. The present findings have implications for the design of intervention efforts to influence adolescents' health behaviors. They suggest that the current emphasis on reducing risks might be broadened to include efforts to strengthen protective factors.

The partitioning of individual differences in protective factors into proximal, health-related factors and distal, conventionality-related factors has been especially illuminating. Although it is to be expected that protective factors more proximal to health would account for more of the variance in health behavior, it turns out that the theoretically linked, but more distal factors—variables having no obvious or immediate implications for health—are also important correlates of health behavior. Religiosity, a commitment to school, having friends who take part in conventional activities like youth groups and community volunteer work, an orientation toward parents, positive relationships with adults, church attendance, and involvement in prosocial activities all turn out to be protective factors associated with adolescent health behavior. According to these findings, a fuller understanding of adolescent health behavior requires an explanatory network that includes distal as well as proximal variables. Such an approach to explanation is a departure from most current efforts, which largely limit their focus to factors proximal to health.

The fact that these same, distal, conventionality-related variables have been shown in earlier work to be related to other domains of behavior as well, such as academic attainment and problem-behavior involvement (Jessor et al., 1991; Jessor et al., in press), suggests that health behavior is part of a larger organization of the person, rather than an isolated aspect or a unique domain. Further, it calls attention to a dimension of individual-differences variation, conventionality–unconventionality, that has relevance for several important domains of adolescent behavior.

The psychosocial risk and protective factors used in this study provide a substantial cumulative account of variation in health-enhancing behavior—39% of the variance after the influence of sociodemographic characteristics has been taken into account. With respect to both risk and protection, individual differences in personality and in characteristics of the perceived social environment are shown to be relevant to health behavior in adolescence. In the final, cross-sectional regression model, the health-specific risk factors that relate negatively to engagement in health-enhancing behavior include felt stress and friends who model eating junk food. The health-specific protective factors that relate positively to health-enhancing behavior include value on health, beliefs about the harmful effects of behaviors such as skipping breakfast and not exercising regularly, and parental models for health-enhancing behavior. The distal protective factors that relate positively to health-enhancing behavior include orientation to school, friends who model conventional behaviors, participation in prosocial activities, and frequent church attendance. These findings link adolescent health behaviors to aspects of personality, the perceived environment, and other behavior, and the relations appear not to vary as a function of sociodemographic characteristics.

It appears, too, that neither developmental changes across the years from middle school to high school nor historical changes over the four waves of the study affected the general patterns of relations of the risk and protection measures to health-enhancing behavior. In the cross-sectional replications in each of the four waves of the study, total variance accounted for in health-enhancing behavior ranged from 41% to 44%, and the proportion of variance accounted for by each set of predictor measures was nearly the same in all waves.

The patterns of relations between risk and protection, on the one hand, and health behavior, on the other, are sustained as well when antecedent risk and protective factors are used to predict subsequent change in health behavior. Health-related risk factors; health-related protective factors; and distal, conventionality-related protective factors were significant predictors of change in health behavior over both a 1-year interval and a 3-year interval (risk marginally significant in the latter). Both health-related and conventionality-related protective factors deserve further study as part of a broader approach to influencing adolescent health behavior than has typically been attempted.

The longitudinal analyses convey important information regarding the development of health-enhancing behavior, but they also speak to two issues of possible confounding in the cross-sectional analyses between risk and protective factors and health behavior. It is possible, and indeed even likely, that there is reciprocal influence in the model we have been exploring. That is, it is possible to argue that health behavior itself might influence the variables used as predictors in this study. Clearly, it is not possible to rule out bidirectionality, but it has been possible to establish some directionality of influence from predictors to criterion in this study by the developmental analyses presented in Table 2. In those analyses, antecedent behavior was controlled, and change in behavior became the criterion. Thus, any variance shared by the Wave-3 predictor and behavior measures was partialed out (Urberg, Degirmencioglu, & Pilgrim, 1997), and what remains—what the regression weights measure—is the influence of the Wave-3 predictors on Wave-4 health behavior. (Of course, as in any study, the possibility that observed relations may be partly due to the influence of unmeasured variables cannot be ruled out.)

The other issue has to do with the fact that all of the measures rely on self-report. It is possible that the key measures of perceived models could be biased by the projection of participants' own characteristics or behavior (see Kandel, 1996; Urberg et al., 1997). Although this, too, cannot be ruled out, the discriminant validity evidence presented for the measures of best friend model for health behavior and participant's own health behavior indicates that the obtained multivariate relations are not merely the result of the confounding of self-reports.

Because protection had been shown to moderate the effect of risk in earlier work (Jessor et al., 1995), and because moderation follows from the logic of the conceptualization of protection, we explored the moderating influence of protection on risk in this study as well. Two small but significant moderating effects of protection on risk were indeed found in the cross-sectional analysis, and both distal and proximal protective factors were shown to moderate health-related risk factors. In each instance of a significant moderator effect, a higher score on a health-related risk factor is significantly associated with less health-enhancing behavior only at below-average levels of the protective factor. Interpretation of these interactions should be tentative, however, given the large number of interaction terms tested. Nevertheless, given the pervasive difficulty of detecting moderating effects in field studies (see McClelland & Judd, 1993), the replication of moderating effects across multiple analyses in the present research, using the composite scale scores as well as the separate factors, and in an independent sample as well, increases conviction about protection as a moderator. The establishment of both direct and moderating effects of protective factors supports recent conceptual efforts to differentiate among the various ways in which protective factors may affect outcomes in different domains (see Luthar, 1993).

The analyses presented in this article relied on a composite index of health-enhancing behavior (the HEBI) as the criterion measure, because principal-components analysis indicated that a single factor underlies the five measures used in the index. Nevertheless, generalizations drawn from the HEBI may not apply equally to all of its components, and indeed, there is substantial variance not shared by the common factor. In order to explore this issue, we replicated the analysis carried out for Table 1 for each of the five health behaviors separately (not tabled; tables available from authors). Those analyses do reveal differences in the relations of the predictor measures to the different behaviors in the composite index. The predictor measures account for larger proportions of the variance in healthy diet, exercise, and seatbelt use (28% to 36%) than they do for sleep and dental hygiene (12% and 15%). There is also variation in the proportions of variance accounted for by the different sets of predictors. For example, the combined proximal health-related risk factors and proximal health-related protective factors account for 32% of variance in healthy diet, compared with only 6% to 12% of variance in each of the other four health behaviors; and sociodemographic measures account for relatively larger proportions of variance in exercise and seatbelt use (10% and 19%, respectively) than in the other behaviors (1% to 5%). It is likely that these differential findings were affected, to some extent at least, by differences in the adequacy and reliability with which the component behaviors were measured. Future assessment of particular health behaviors should employ more elaborate and more equivalent measurement efforts for each component of the behavioral criterion than we were able to do. In the meantime, the use of a composite index has the advantage of having mapped diverse aspects of the health behavior domain and of having assessed that domain more comprehensively.

The study has several limitations that constrain the inferences that may be drawn. First, although the protection measures include many multiple-item, well-established scales that have been used in a wide range of studies, the measures of health-specific risk include several single-item measures, most of which had not been employed in prior research. Inadequacy of the risk measures may account, at least in part, for their relatively limited predictiveness compared with the predictiveness of the protection measures. Another limitation is that the risk and protective factor measures and the criterion measure all relied on self-report, and the obtained relations could be spuriously inflated by common method variance. Finally, the less-than-desirable initial participation rate of the sample drawn and the attrition of the starting sample over the subsequent 3 years deserve mention as potential limitations on the generality of inference that is possible.

Despite these limitations, the present study expands on prior knowledge about adolescent health-enhancing behavior in four major ways. First, unlike much previous work that has focused on negative, health-compromising behaviors, the present study illuminates factors associated with positive, health-enhancing behaviors. Second, the present research goes beyond an emphasis on health risk factors to include an examination of health protective factors as well. Third, the study shows that protective factors distal from health behavior are also related to its occurrence and development. And fourth, the research suggests that there is some moderating effect of protection on the impact of health-related risk. Taken together, such knowledge can be useful in illuminating the development of health-enhancing behavior and informing interventions designed to promote health behaviors in adolescence.

References

Adeyanju, M. (1990). Adolescent health status, behaviors and cardiovascular disease. *Adolescence, 25,* 155–169.

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions.* Newbury Park, CA: Sage.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173–1182.

Becker, M. H. (Ed.). (1974). The health belief model and personal health behavior. *Health Education Monographs, 2*(Whole No. 4).

Cohen, J., & Cohen, P. (1983). Applied multiple regression/correlation analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Erlbaum.

Costa, F. M., Jessor, R., & Turbin, M. S. (in press). Transition into adolescent problem drinking: The role of psychosocial risk and protective factors. *Journal of Studies on Alcohol.*

Donovan, J. E., Jessor, R., & Costa, F. M. (1991). Adolescent health behavior and conventionality–unconventionality: An extension of problem-behavior theory. *Health Psychology, 10,* 52–61.

Donovan, J. E., Jessor, R., & Costa, F. M. (1993). Structure of health-enhancing behavior in adolescence: A latent-variable approach. *Journal of Health and Social Behavior, 34,* 346–362.

Edwards, W. (1954). The theory of decision making. *Psychological Bulletin, 51,* 380–417.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research.* Reading, MA: Addison-Wesley.

Gillis, A. J. (1994). Determinants of health-promoting lifestyles in adolescent females. *Canadian Journal of Nursing Research, 26,* 13–28.

Gottlieb, N. H., & Chen, M. (1985). Sociocultural correlates of childhood sporting activities: Their implications for heart health. *Social Science and Medicine, 21,* 533–539.

Haskell, W. L. (1984). Overview: Health benefits of exercise. In J. D. Matarazzo, S. M. Weiss, J. A. Herd, N. E. Miller, & S. M. Weiss (Eds.), *Behavioral health: A handbook of health enhancement and disease prevention* (pp. 409–423). New York: Wiley.

Jessor, R. (1984). Adolescent development and behavioral health. In J. D. Matarazzo, S. M. Weiss, J. A. Herd, N. E. Miller, & S. M. Weiss (Eds.), *Behavioral health: A handbook of health enhancement and disease prevention* (pp. 69–90). New York: Wiley.

Jessor, R., Donovan, J. E., & Costa, F. M. (1991). *Beyond adolescence: Problem behavior and young adult development.* New York: Cambridge University Press.

Jessor, R., & Jessor, S. L. (1977). *Problem behavior and psychosocial* *development: A longitudinal study of youth.* New York: Academic Press.

Jessor, R., Turbin, M. S., & Costa, F. M. (in press). Risk and protection in successful outcomes among disadvantaged adolescents. *Applied Developmental Science.*

Jessor, R., Van Den Bos, J., Vanderryn, J., Costa, F. M., & Turbin, M. S. (1995). Protective factors in adolescent problem behavior: Moderator effects and developmental change. *Developmental Psychology, 31,* 923–933.

Jöreskog, K. G., & Sörbom, D. (1989). *LISREL 7: A guide to the program and applications.* Chicago: SPSS.

Judd, C. M., & McClelland, G. H. (1989). *Data analysis: A model comparison approach.* San Diego, CA: Harcourt Brace Jovanovich.

Kandel, D. B. (1996). The parental and peer contexts of adolescent deviance: An algebra of interpersonal influences. *Journal of Drug Issues, 26,* 289–315.

Lonnquist, L. E., Weiss, G. L., & Larsen, D. L. (1992). Health value and gender in predicting health protective behavior. *Women & Health, 19,* 69–85.

Luthar, S. S. (1993). Annotation: Methodological and conceptual issues in research on childhood resilience. *Journal of Child Psychology and Psychiatry, 34,* 441–453.

MacMahon, B., Pugh, T. F., & Ipsen, J. (1960). *Epidemiological methods.* Boston: Little, Brown.

Maggs, J. L., Schulenberg, J., & Hurrelmann, K. (1997). Developmental transitions during adolescence: Health promotion implications. In J. Schulenberg, J. L. Maggs, & K. Hurrelmann (Eds.), *Health risks and developmental transitions during adolescence* (pp. 522–546). New York: Cambridge University Press.

Matarazzo, J. D. (1984). Behavioral health: A 1990 challenge for the health services professions. In J. D. Matarazzo, S. M. Weiss, J. A. Herd, N. E. Miller, & S. M. Weiss (Eds.), *Behavioral health: A handbook of health enhancement and disease prevention* (pp. 3–40). New York: Wiley.

McClelland, G. H., & Judd, C. M. (1993). Statistical difficulties of detecting interactions and moderator effects. *Psychological Bulletin, 114,* 376–390.

Meredith, C. N., & Dwyer, J. T. (1991). Nutrition and exercise: Effects on adolescent health. *Annual Review of Public Health, 12,* 309–333.

Oleckno, W. A., & Blacconiere, M. J. (1991). Relationship of religiosity to wellness and other health-related behaviors and outcomes. *Psychological Reports, 68,* 819–826.

Prentice-Dunn, S., & Rogers, R. W. (1986). Protection motivation theory and preventive health: Beyond the health belief model. *Health Education Research, 1,* 153–161.

Rivas Torres, R., & Fernandez Fernandez, P. (1995). Self-esteem and value of health as determinants of adolescent health behavior. *Journal of Adolescent Health, 16,* 60–63.

Ronis, D. L. (1992). Conditional health threats: Health beliefs, decisions, and behaviors among adults. *Health Psychology, 11,* 127–134.

Rutter, M. (1987). Psychosocial resilience and protective mechanisms. *American Journal of Orthopsychiatry, 57,* 316–331.

Sallis, J. F. (1993). Promoting healthful diet and physical activity. In S. G. Millstein, A. C. Petersen, & E. O. Nightingale (Eds.), *Promoting the health of adolescents: New directions for the twenty-first century* (pp. 209–241). New York: Oxford University Press.

Saunders, D. R. (1956). Moderator variables in prediction. *Educational and Psychological Measurement, 16,* 209–222.

Sussman, S., Dent, C. W., Stacy, A. W., Burton, D., & Flay, B. R. (1995). Psychosocial predictors of health risk factors in adolescents. *Journal of Pediatric Psychology, 20,* 91–108.

Urberg, K. A., Degirmencioglu, S. M., & Pilgrim, C. (1997). Close friend and group influence on adolescent cigarette smoking and alcohol use. *Developmental Psychology, 33,* 834–844.

Weinstein, N. D. (1993). Testing four competing theories of health-protective behavior. *Health Psychology, 12,* 324–333.

Weiss, G. L., Larsen, D. L., & Baker, W. K. (1996). The development of health protective behaviors among college students. *Journal of Behavioral Medicine, 19,* 143–161.

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