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# Predicting Developmental Change in Healthy Eating and Regular Exercise Among Adolescents in China and the United States: The Role of Psychosocial and Behavioral Protection and Risk

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This article reports a cross-national study of developmental change in health-enhancing behavior—healthy eating and regular exercise—among adolescents in China and the United States. The application of a conceptual framework comprising psychosocial and behavioral protective and risk factors—both proximal and distal and at both the individual and social contextual level—is shown to provide a substantial account of variation in change in those behaviors over a 2-year interval. The explanatory account has generality across gender, the 3 grade cohorts, and most importantly, across the 2 markedly diverse societies.

This article seeks to advance understanding of the psychosocial and behavioral protective and risk factors associated with developmental change in healthy eating and regular exercise behaviors in adolescent samples from two very diverse societies, the People's Republic of China and the United States. Achieving a better grasp on adolescent dietary and exercise behaviors has gained greater urgency because of what is now commonly known as an ''obesity epidemic,'' not only in the United States but in other industrialized countries and in developing countries as well (Centers for Disease Control [CDC], 2004; Wadden, Brownell, & Foster, 2002; World Health Organization, 2002). There have been dramatic increases in the prevalence of overweight among children and adolescents (Kohn & Booth, 2004; Kohn et al., 2006; Lytle, 2002; Ogden, Flegal, Carroll, & Johnson, 2002). Between 1976–1980 and 2003–2004, the percentage of overweight adolescents (aged 12–19) tripled (CDC, 2007); 17% of young people aged 12–19 in this country

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were overweight in 2003–2004 (CDC, 2007). Furthermore, overweight adolescents stand a 70–80% chance of becoming overweight adults (Dietz, 2004; U.S. Surgeon General, 2003).

It is largely variation in behavior—in dietary patterns and in physical activity—that is associated with observed differences in overweight and obesity. Higher levels of caloric and fat intake and lower levels of physical activity (and/or higher levels of inactivity) have been shown to be positively associated with overweight/obesity among adolescents (e.g., Berkey et al., 2000; Crespo et al., 2001; Giammattei, Blix, Marshak, Wollitzer, & Pettitt, 2003). In addition, data indicate that adolescents' involvement in various health-enhancing behaviors, including healthy eating and physical exercise, tends to decline as adolescents age (Duncan, Duncan, Strycker, & Chaumeton, 2007; Harris, King, & Gordon-Larson, 2005; Jessor, Turbin, & Costa, 1998; Pate et al., 2009; Turbin et al., 2006).

Only a few studies have examined psychosocial and behavioral factors associated with developmental change in adolescent health-enhancing behaviors. Longitudinal studies of small samples of adolescent girls and boys indicate that changes in exercise-specific social contextual factors (e.g., social support and models for exercise) are associated with change in physical activity (DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998; Duncan et al., 2007; Motl et al., 2005; Neumark-Sztainer, Story, Hannan, Tharp, & Rex, 2003). Our own earlier work has shown that antecedent psychosocial protective and risk factors are associated with subsequent development of health-enhancing behavior in adolescence (Jessor et al., 1998), and that changes in social contextual protective and risk factors are associated with a 1-year developmental decline in adolescent involvement in health-enhancing behavior (Turbin et al., 2006).

Unlike theoretical approaches that have focused on predominantly *proximal* influences on health behavior, that is, influences that directly and obviously implicate or reference those behaviors (Ajzen, 1985; Bandura, 1986; Fishbein et al., 2001; Rosenstock, Strecher, & Becker, 1994), the framework used in the present study also examines *distal* influences, that is, those that do not directly or obviously implicate the health-related behaviors and that are linked to those behaviors only theoretically. Examples of proximal influences on health-related behavior include self-efficacy for healthy eating or for physical activity; intention to eat a healthful diet or to exercise; and social models for eating healthy/unhealthy foods or for exercise (Salovey, Rothman, & Rodin, 1998). Examples of distal influences include religiosity, sense of self-worth, school achievement, and family closeness, among others (see Jessor & Jessor, 1977).

Earlier theory-based work that included both proximal and distal protective and risk factors showed that distal psychosocial factors accounted for unique variation in adolescent health behavior, as well as in developmental change in that behavior over time (Donovan, Jessor, & Costa, 1991; Jessor

et al., 1998; Turbin et al., 2006). That is, conceptually distal protective and risk factors remained significant correlates of health behavior in adolescence, even after the effects of the proximal factors had been accounted for (see Turbin et al., 2006).

The explanatory model used in the present study articulates protective and risk factors in multiple conceptual domains: those that are distal and proximal; those that are psychosocial and behavioral; and those at the individual level as well as at the social contextual level. Protective factors are variables that promote positive, prosocial, or health-enhancing behavior. Risk factors, on the other hand, are variables that instigate problem or risk behaviors or behaviors that are health compromising. Although there is considerable questioning in the literature about the relation between protective factors and risk factors, our theoretical framework posits them as orthogonal (see Jessor, Van Den Bos, Vanderryn, Costa, & Turbin, 1995). That is, to take the protective factor of religiosity as one example, whereas high religiosity is theoretically promotive/protective, low religiosity is considered simply as low protection rather than as a risk factor, because low religiosity does not, theoretically, instigate problem or health-compromising behavior. In short, low protection simply does not, theoretically, imply high risk. Both protection and risk factors are specified only by their theoretical properties, not by their opposite positions on a particular dimension.

The content of the present explanatory model was derived from the constructs of Problem-Behavior Theory (Jessor, 1984: Jessor, Donovan, & Costa, 1991; Jessor & Jessor, 1977), including its more recent extension to adolescent behaviors in other domains (Jessor et al., 1995, 1998). Both psychosocial protective factors and psychosocial risk factors have been articulated. In addition, *other behaviors* have been specified theoretically as either protective factors, for example, attendance at religious services, or risk factors, for example, problem drinking.

The conceptual structure of the explanatory framework is shown in Figure 1. As can be seen, the differentiated sets of promotive/protective factors and of risk factors have direct relationships with the two health-enhancing criterion behavior measures, attention to healthy eating and hours per week of regular exercise. Because the theoretical framework also posits a moderating effect of protection on the impact of exposure to risk (see Jessor et al., 1995), that is illustrated by the dotted arrow between the protective factors and the arrow representing the effects of the risk factors on health-enhancing behaviors. The actual measures of the differentiated protective and risk factors used in the present study reflect considerable prior research in which their validity and predictability have been established. As will be seen in Table 1 below, however, not all of the measures needed to assess the various categories of risk factors were available in the present data set, and the asterisks in Figure 1 indicate the missing measurement domains.

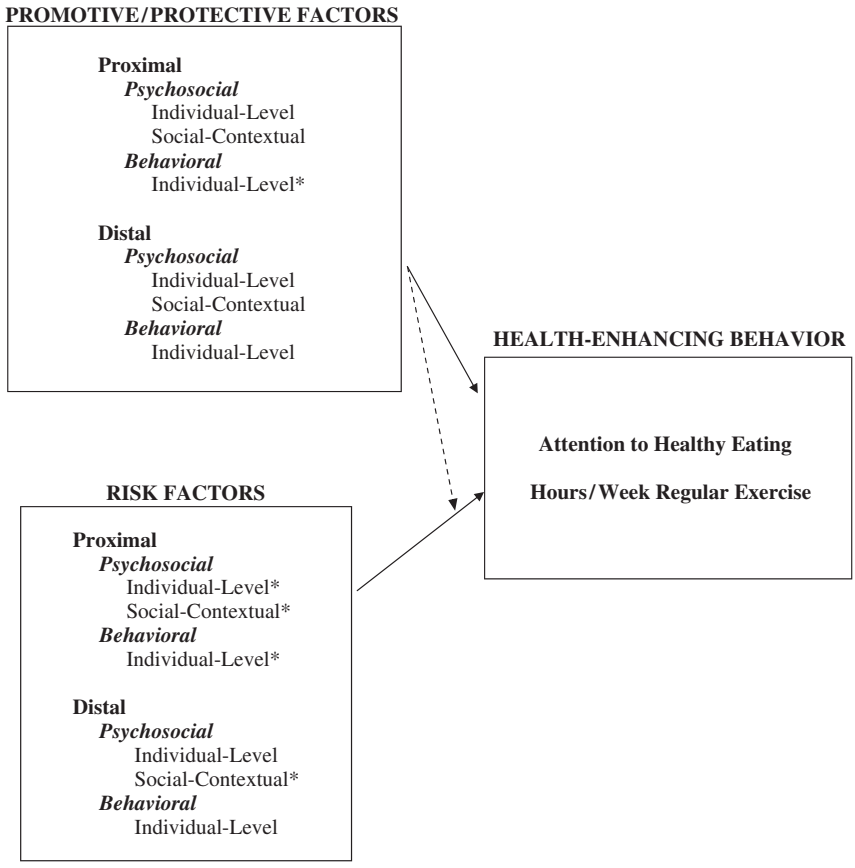


FIGURE 1 Protective and risk factor conceptual framework (*Variables not assessed in this study).

The general hypothesis of the study is that variation in protection and risk can provide a significant account of variation in adolescent health-enhancing behavior as well as in its developmental change from early to mid-adolescence. Further, because the account is at the theoretical or underlying or causal level, rather than at the descriptive level, it should have generality across adolescent samples from even so widely differing societal contexts as those of the People's Republic of China and the United States (see Jessor, 2008).

## METHOD

### Participants

The data in this paper are from two waves—2 years apart—of a questionnaire survey of adolescents in Beijing, China, and in a large urban area in the Rocky

TABLE 1
Description of Measures

| | | *Cronbach's α* | | *Example Item* | |
|---|---|---|---|---|---|
| *Measure* | *# of Items* | *United States* | *China* | *Question* | *Response Scale* |
| Health-enhancing behavior | | | | | |
| Attention to healthy eating | 5 | .87 | .85 | Do you pay attention to eating some fresh vegetables every day? | 1 (*none*), 2 (*some*), 3 (*a lot*) |
| Hours per week of regular exercise | 3 | .63 | .71 | About how many hours do you usually spend each week taking part in an organized sport or recreation program (like soccer or karate)? | 1 (*none*) to 6 (*8 or more hours a week*) |
| Psychosocial protection: proximal-individual | | | | | |
| Value on health | 5 | .88 | .73 | How important is it to you to keep yourself in good health all year round? | 1 (*not too important*) to 4 (*very important*) |
| Perceived effects of unhealthy diet | 2 | .72 | .78 | Do you think eating a lot of "junk food" can have an effect on the health of young people your age? | 1 (*almost no effect*) to 4 (*very serious effect*) |
| Perceived effects of insufficient exercise | 1 | — | — | Do you think not getting enough exercise can have an effect on the health of young people your age? | 1 (*almost no effect*) to 4 (*very serious effect*) |
| Psychosocial protection: proximal-contextual | | | | | |
| Models for healthy diet | 3 | .52 | .59 | Do your parents (or the adults you live with) pay attention to eating a healthy diet themselves? | 1 (*almost no attention*) to 3 (*a lot of attention*) |
| Models for adequate exercise | 3 | .56 | .62 | How many of your friends make sure they get enough exercise? | 1 (*none*) to 4 (*all of them*) |
| Friends controls for unhealthy behavior | 1 | — | — | If you were doing something that is bad for your health, would your friends try to get you to stop? | 1 (*definitely would not*) to 4 (*definitely would*) |
| Psychosocial protection: distal-individual | | | | | |
| Intolerance of deviance | 10 | .90 | .94 | How wrong do you think it is to shoplift from a store? | 1 (*not wrong*) to 4 (*very wrong*) |
| Attitude toward school | 4 | .80 | .82 | I am learning a lot from being in school | 1 (*strongly disagree*) to 4 (*strongly agree*) |

TABLE 1 (Contd.)

| Measure | # of Items | Cronbach's α | | Example Item | |
|---|---|---|---|---|---|
| | | United States | China | Question | Response Scale |
| Psychosocial protection: distal-contextual | | | | | |
| Models for conventionality | 8 | .72 | .78 | How many of your friends do volunteer work in the community? | 1 (*none*) to 4 (*all of them*) |
| Friends controls for unconventionality | 3 | .79 | .72 | If you were going to do something that is against the law, would your friends try to talk you out of it? | 1 (*definitely would not*) to 4 (*definitely would*) |
| Behavioral protection: distal-individual | | | | | |
| Multiple prosocial behavior index (MPSBI) | 13[a] | .46[b] | .33[b] | How many times have you gone to church or religious or spiritual services during the past 6 months? | 1 (*none*) to 6 (*once a week or more*) |
| Psychosocial risk: distal-individual | | | | | |
| Depressive mood | 4 | .86 | .85 | In the past 6 months, have you just felt really down about things? | 1 (*not at all*) to 4 (*a lot*) |
| Felt stress | 3 | .76 | .70 | In the past 6 months, how much stress or pressure have you felt at home? | 1 (*none at all*) to 4 (*a lot*) |
| Low self-esteem | 6 | .65 | .66 | On the whole, how satisfied are you with yourself? | 1 (*very satisfied*) to 4 (*not satisfied at all*) |
| Low expectations | 9 | .90 | .87 | What are the chances that you will have a job that pays well? | 1 (*very high*) to 5 (*very low*) |
| Behavioral risk: distal-individual | | | | | |
| Multiple problem behavior index (MPBI) | 20[c] | .61[b] | .49[b] | During the past 6 months, how often have you hit another student because you did not like what he or she did? | 1 (*never*) to 5 (*5 or more times*) |

[a]The MPSBI is the sum of *z*-scores on four components—usual grades, school and community activities, family activities, and attending religious services; each comprises from 1 to 6 items.

[b]Two-year stability coefficients are given in place of Cronbach's α for the behavior indexes, because α is not appropriate for an index.

[c]The MPBI is the sum of *T*-scores on three components—delinquent behavior, cigarette smoking, and problem drinking; each comprises from 2 to 10 items.

Mountain region of the United States. At the first wave, the participants were in early adolescence, ranging in age from 13 to 15; at the second wave, they were in mid-adolescence, age 15–17. In each country, the sample was drawn from schools chosen in consultation with the school district administration to best represent variation in the socioeconomic backgrounds of the students and, in the United States, to reflect the racial/ethnic composition of students in the district. In Beijing, seven junior high schools (grades 7, 8, and 9) were selected from two districts—one within the city and the other in the suburbs—and, in each district, schools known to vary in educational quality were selected. In the United States, six middle schools (for grades 7 and 8) and three high schools (for grade 9) were selected. In each school, classrooms were randomly sampled within grade for participation in the study.[1]

In both research sites, research staff administered the questionnaire in large groups at school, with teachers absent. Active parental permission and personal assent were required, and confidentiality was explained and guaranteed by a Confidentiality Certificate from the U.S. Department of Health and Human Services. Each student received a token payment for filling out the questionnaire, in the United States, $5 at Wave 1 and $10 at Wave 2; in China, $2 at each wave, plus a gift to each school.

At the first wave of data collection (Fall 2000), questionnaires were completed by 1,739 study participants from Beijing (98% of the designated sample; 883 boys, 856 girls) and by 1,596 participants from the United States (74% of the designated sample; 753 boys, 843 girls). At the Wave-2 data collection (Fall 2002), questionnaires were completed by 2,533 of the original participants (1,392, 80% of the Wave-1 China sample; 1,141, 71% of the Wave-1 U.S. sample). The 2002 data have not hitherto been reported. More details regarding composition of the samples were reported in Jessor et al. (2003).

## Measures

A 36-page Adolescent Health and Development Questionnaire (AHDQ) was used to assess a broad range of risk behaviors and protective (positive, prosocial) behaviors, as well as psychosocial protective and risk factors in five domains: the individual (including personal beliefs, values, attitudes, and expectations), and four key social contexts—family, peer group, school, and neighborhood/community. The AHDQ had been developed over the past several decades, with its content theoretically derived from the constructs in Problem-Behavior Theory. It was translated into Chinese and back translated

[1] To address the possible nonindependence of observations on the criterion measure within schools and the possible need for hierarchical linear modeling, we computed the intraclass correlations of all the criterion measures within schools. They ranged from .00 to .05, and all had 95% confidence intervals (adjusted for unequal cluster sizes) that included zero, so they were deemed negligible, and the students' responses were treated as independent observations.

twice by bilingual Chinese scholars to insure that *meaning equivalence* (Knight & Hill, 1998) had actually been achieved (see Jessor et al., 2003).

***Measurement of attention to healthy eating and hours/week regular exercise behaviors.*** Measures of two health-enhancing behaviors relevant to adolescent overweight/obesity were included in the AHDQ: self-report of attention to eating a healthy diet and hours per week of regular exercise; both are shown in Table 1. The full AHDQ can be found at http://www.colorado.edu/ibs/jessor/questionnaires/questionnaire_ahdq3.pdf

***Measurement of protective factors and risk factors.*** Measures of protection and risk were based on the theoretical properties described earlier; comprehensive descriptions of their rationale as indicators of protection and risk are presented elsewhere (Costa et al., 2005; Jessor et al., 2003; Turbin et al., 2006). A description of each measure is presented in Table 1. Protective factors and risk factors were assessed by multiple items for the most part, and scores for each measure were computed as averages of equally weighted items. For the social-contextual measures, the adolescent respondent characterized protection and risk as perceived in the social settings navigated in his/her everyday life. Thus, all of the social context measures in the AHDQ are *perceived* context measures.

Wave-2 reliabilities of the protective- and risk-factor measures are, for the most part, quite similar between the two country samples and were in the range of .52–.90. Stability coefficients were mostly in the .30s and .40s, showing considerable stability over a 2-year period for the two health-enhancing behavior criterion measures and for the protection and risk predictors.

Correlations among the protective factor measures are mostly in the .20s; correlations among the risk-factor measures are mostly in the .20s or smaller. Correlations between the protective factors and the risk factors were mostly negative, as expected, and mostly smaller than .20 in absolute value. Overall, the correlations are of similar magnitude in the two country samples.

## RESULTS

### Accounting for Variation in Attention to Healthy Eating and Hours Regular Exercise: Cross-Sectional Analyses

The theoretical model was applied cross-sectionally to each Wave-2 criterion measure before analyzing Wave-1 to Wave-2 developmental change in those measures. Sociodemographic background measures were included in each analysis to partial out effects of sex, grade in school, intactness of family (both biological parents living together at both waves), SES (father's job level and

father's and mother's education at Wave 2), and ethnicity (U.S. only, White/non-White).

Regressing the attention to healthy eating criterion measure on the sets of protective and risk factors accounted for 29% of the variance in each country sample. Regression weights were significant in both samples for the proximal protective factors of value on health, perceived effects of unhealthy diet, and models for healthy diet, and for the distal protective factor, friends controls for unconventionality. Felt stress and the multiple prosocial behavior index (MPSBI) were also significant in the U.S. sample; attitude toward school, models for conventionality, and low expectations were also significant in the China sample (not tabled; tables are available from the authors).

The same analysis for the hours per week regular exercise measure accounted for 25% of the variance in the U.S. sample and 23% in the China sample. Significant regression weights were obtained, in both country samples, for the proximal protective factors of perceived effects of insufficient exercise and models for adequate exercise, for the distal protective factor of the MPSBI, and for the distal risk factor of low self-esteem. In the U.S. sample, an additional proximal protective factor, value on health, and an additional distal risk factor, depressive mood, were also significant.

### Accounting for Developmental Change in Attention to Healthy Eating and Hours Regular Exercise Over Time: Longitudinal Analyses

Repeated-measures, multivariate analysis of variance within each country-by-sex subgroup revealed a significant decline over the 2-year interval in mean scores on the attention to healthy eating measure for both sexes in both country samples; in addition, there was a significant decline on the hours regular exercise measure for both sexes in the China sample (not tabled; tables available from the authors). Thus, involvement in each criterion behavior declined over the 2-year interval in either one or both of the two country samples, and no group showed a significant increase on either behavior measure.

In order to provide a systematic account of change—largely decline—in healthy eating and regular exercise behavior, *changes in protective and risk factors* were used as predictors in a hierarchical regression analysis for each criterion measure in each country sample. Change in each behavioral criterion variable was operationalized by entering its Wave-1 measure at Step 1 of the regression analysis, with its Wave-2 measure as the dependent variable to be predicted (see Table 2). This procedure yields a Wave-2 criterion measure the variance of which is unrelated to the Wave-1 measure, that is, it provides a measure of *change* in the criterion measure between Wave 1 and Wave 2 (see Cohen & Cohen, 1983, pp. 414–423; Dalecki & Willits, 1991).

At Step 2 of each regression, the sociodemographic background measures were entered. At Step 3, all nine Wave-1 protective-factor measures were entered, followed at Step 4 by the Wave-2 measures of those same nine

TABLE 2
Hierarchical Regression of Wave-1 to Wave-2 *Change* in Attention to Healthy Eating and in Hours Regular Exercise on Wave-1 to Wave-2 *Change* in Protective and Risk-Factor Measures, Final Model

| | *U.S. Sample (N = 894)* | | | | *China Sample (N = 1,154)* | | | |
|---|---|---|---|---|---|---|---|---|
| *Step and Measures Entered* | *r* | β | $\Delta R^2$ | $R^{2a}$ | *r* | β | $\Delta R^2$ | $R^{2a}$ |
| | Change in attention to healthy eating | | | | | | | |
| 1. Wave-1 attention to healthy diet | .47 | .34*** | .22*** | .22 | .34 | .22*** | .11*** | .11 |
| 2. Sociodemographic background | | | .01 | .23 | | | .01* | .12 |
| Sex | −.02 | −.03 | | | .01 | .02 | | |
| White/non-White | −.13 | −.01 | | | — | — | | |
| Grade in school | −.13 | −.02 | | | −.06 | .03 | | |
| Socioeconomic status | −.04 | .06 | | | .09 | .03 | | |
| Intact family | −.04 | −.07* | | | −.02 | −.04 | | |
| 3. Wave-1 protective factors | | | .02* | .24 | | | .03*** | .15 |
| 4. Wave-2 protective factors | | | .14*** | .39 | | | .17*** | .32 |
| Value on health | .37 | .17*** | | | .24 | .06* | | |
| Perceived effects of unhealthy diet | .36 | .20*** | | | .37 | .19*** | | |
| Models for healthy diet | .38 | .19*** | | | .41 | .22*** | | |
| Friends controls for unhealthy behavior | .18 | −.07 | | | .17 | −.07 | | |
| Intolerance of deviance | .25 | .04 | | | .17 | .01 | | |
| Attitude toward school | .24 | .00 | | | .29 | .07** | | |
| Models for conventionality | .29 | .01 | | | .28 | .06* | | |
| Friends controls for unconventionality | .21 | .10* | | | .23 | .09* | | |
| Multiple prosocial behavior index (MPSBI) | .19 | .09** | | | .15 | .04 | | |
| 5. Wave-1 risk factors | | | .01* | .40 | | | .01 | .33 |
| 6. Wave-2 risk factors | | | .002 | .40 | | | .01*** | .34 |
| Depressive mood | −.03 | .00 | | | −.06 | −.02 | | |
| Felt stress | −.10 | −.02 | | | .04 | .05 | | |
| Low self-esteem | −.14 | .03 | | | −.22 | −.03 | | |
| Low expectations | −.17 | −.01 | | | −.24 | −.10*** | | |
| Multiple problem behavior index (MPBI) | −.15 | .05 | | | −.14 | −.05 | | |

TABLE 2 (Contd.)

| | *U.S. Sample (N = 894)* | | | | *China Sample (N = 1,154)* | | | |
|---|---|---|---|---|---|---|---|---|
| *Step and Measures Entered* | *r* | β | $\Delta R^2$ | $R^{2a}$ | *r* | β | $\Delta R^2$ | $R^{2a}$ |
| | Change in hours/week regular exercise | | | | | | | |
| 1. Wave-1 regular exercise | .49 | .38*** | .24*** | .24 | .42 | .29*** | .18*** | .18 |
| 2. Sociodemographic background | | | .03*** | .27 | | | .04*** | .22 |
| Sex | −.17 | −.07* | | | −.30 | −.18*** | | |
| White/non-White | .07 | .02 | | | — | — | | |
| Grade in school | −.03 | .00 | | | .07 | .04 | | |
| Socioeconomic status | .21 | .04 | | | .06 | .01 | | |
| Intact family | .08 | .04 | | | .04 | .06* | | |
| 3. Wave-1 protective factors | | | .02** | .29 | | | .02 ** | .23 |
| 4. Wave-2 protective factors | | | .07*** | .35 | | | .06*** | .29 |
| Value on health | .25 | .17*** | | | .09 | .04 | | |
| Perceived effects of insufficient exercise | .18 | .02 | | | .21 | .07** | | |
| Models for adequate exercise | .24 | .05 | | | .21 | .06* | | |
| Friends controls for unhealthy behavior | .04 | −.03 | | | .04 | .04 | | |
| Intolerance of deviance | .04 | −.02 | | | −.02 | .01 | | |
| Attitude toward school | .13 | .03 | | | .05 | −.08 | | |
| Models for conventionality | .21 | .01 | | | .22 | .07** | | |
| Friends controls for unconventionality | .04 | −.01 | | | .05 | .03 | | |
| MPSBI | .29 | .13*** | | | .20 | .17*** | | |
| 5. Wave-1 risk factors | | | .00 | .35 | | | .01 | .30 |
| 6. Wave-2 risk factors | | | .02*** | .37 | | | .02*** | .32 |
| Depressive mood | −.19 | −.09** | | | −.06 | −.06* | | |
| Felt stress | −.08 | .00 | | | −.06 | −.05 | | |
| Low self-esteem | −.34 | −.11** | | | −.27 | −.10*** | | |
| Low expectations | −.22 | −.01 | | | −.09 | .03 | | |
| MPBI | −.02 | .06 | | | .14 | .10 | | |

*Note*. All bivariate correlations with absolute magnitude greater than .05 are significant at $p \leq .05$ (one-tailed test). All $R^2$ are significant at $p < .001$.

[a]One fourth of the variance in *change* in attention to healthy eating (the residual variance after Step 1) was accounted for (23% United States, 26% China) and one sixth of the variance in *change* in regular exercise was accounted for (17% in each sample). (See text.)

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$.

variables.[2] The Wave-1 and Wave-2 measures of the five risk factors were then entered at Steps 5 and 6, respectively. Thus, the Wave-2 theoretical predictors, entered at Steps 4 and 6, reflect variation in the Wave-2 protective and risk factors that is unrelated to the variation in their respective Wave-1 measures. That is, they reflect variation in *change* in protection and risk, and their regression coefficients represent, therefore, the relation of *change* in the protective and risk factors to *change* in the two criterion measures.

As the Wave-2 bivariate correlations of the theoretical predictors with the two criterion measures indicate in Table 2, for nearly all the predictors, the expected positive relations between the protective-factor measures and the health-enhancing behaviors and the expected negative relations between the risk-factor measures and the health-enhancing behaviors hold, although a few correlations are essentially zero, and the multiple problem behavior index has a positive correlation (.14) with hours regular exercise in the China sample.

A significant proportion of variance in change in each criterion variable was accounted for at Step 4 by change in the nine protection measures, as shown by the $\Delta R^2$ in Table 2 (14% U.S. sample, 17% China sample for the attention to healthy eating criterion measure; 7% United State, 6% China for the hours regular exercise measure, all significant at $p < .001$). At Step 6, change in the five risk-factor measures added another significant increment in variance accounted for in change in the attention to healthy eating criterion variable in the China sample only (1%, $p < .001$) and in change in the hours regular exercise criterion variable in both samples (2% in each sample, $p < .001$).

Those last three percentages indicate the proportions of variance accounted for *uniquely* by change in the risk factors because they were entered in the last step, Step 6, of the hierarchical regressions, after all other predictors had already been entered. Because the protective and risk factors share common variance, supplementary regression analyses were carried out to establish the variance accounted for uniquely by change in the protective factors. In these supplementary analyses, the Wave-2 measures of protective factors were now entered at the last step of the regression model, after all other protective- and risk-factor measures had been entered. This analysis showed that the protective factors accounted uniquely for 13% of variance in change in the attention to healthy eating measure in the U.S. sample and 12% in the China sample, both substantially more than the 1% or less accounted

[2] For each criterion measure, the proximal protective factor measures specific to the other criterion behavior were excluded from the analysis, that is, perceived health effects of inadequate exercise and models for adequate exercise were not included as predictors of attention to healthy eating, and perceived health effects of unhealthy diet and models for healthy diet were not included as predictors of hours regular exercise.

for uniquely by the risk factors, as indicated above. The protective factors accounted uniquely for 4% (United States) and 6% (China) of variance in change in the hours regular exercise measure, again more than the 2% accounted for uniquely by the risk factors.

Because the residual variance in each Wave-2 criterion measure ($1 - R^2$) *after* the Step 1 entry of its Wave-1 measure is not related to the variance in its Wave-1 measure, it can be considered *the total variance in change* in that criterion measure to be accounted for. Increments in $R^2$ at subsequent steps of the regression should, therefore, be divided by that residual variance in order to represent appropriately the proportion of variance accounted for in change in the criterion variable. Thus, the variance accounted for in change in attention to healthy eating is the total increase in $R^2$ after Step 1 (.18) divided by (1 − .22), or 23%, in the U.S. sample and .23/(1 − .11), or 26%, in the China sample. This is a substantial account, about a quarter of the variance in developmental change in attention to healthy diet, and it has generality across both country samples. Similarly, the total variance accounted for in change in hours regular exercise is .13/(1 − .24) in the U.S. sample, and .14/(1 − .18) in the China sample, or 17% in each country sample, again substantial.

With respect to change in the criterion measure of attention to healthy eating, change in the protective factors of value on health, perceived effects of unhealthy diet, models for healthy diet, and friends controls for unconventionality were significant in both samples. Changes in the distal protective factors of attitude toward school and models for conventionality and in the distal risk factor of low expectations were also significant in the China sample; change in the distal protective factor, the MPSBI, was also significant in the U.S. sample.

In the regression analysis of change in the hours regular exercise criterion measure, changes in the distal protective factor, the MPSBI, and in the distal risk factors, depressive mood and low self-esteem, were significant in both samples. Change in value on health was also significant in the U.S. sample, and in the China sample, changes in perceived effects of insufficient exercise, in models for adequate exercise, and in models for conventionality were also significant.

Interactions of sex and of grade cohort with each of the 14 Wave-2 protective- and risk-factor measures were examined for each criterion measure in each country sample. Adding the 14 sex interaction terms at the final step of each hierarchical regression model accounted for no significant increment in variance accounted for. Adding the 14 cohort interactions at the final step provided a significant ($p < .05$) increment in the $R^2$ for change in the attention to healthy eating measure in the U.S. sample and showed that depressive mood was a significant risk factor only for the youngest grade cohort in that sample. The cohort interactions also provided a significant ($p < .05$) increment in the $R^2$ for change in the hours regular exercise measure in the China

sample and showed that value on health and models for adequate exercise were significant protective factors only for the youngest cohort in that sample. All together, then, there was no significant sex interaction for either measure in either sample, and only 3 of the 56 cohort interaction terms tested in the four regression analyses of change were significant. Thus, these results suggest that the explanatory model of developmental change in health-enhancing behavior has generality across both sexes and, for the most part, across the three grade/age cohorts.

Testing for moderator effects of protection on the impact of exposure to risk yielded no significant interactions for either criterion measure in either country sample.

The key proximal, psychosocial protective factors in these longitudinal analyses, for both country samples, were at the individual level (changes in value on health and in perceived effects of unhealthy diet) and at the contextual level (changes in models for healthy diet). Key distal measures included individual-level psychosocial risk (depressive mood and low self-esteem), contextual-level psychosocial protection (friends controls for unconventionality), and individual-level, behavioral protection (the MPSBI). Five additional psychosocial protective and risk factors, both individual and contextual and both proximal and distal, were significant for the China sample: changes in perceived effects of insufficient exercise, in attitude toward school, in low expectations, in models for adequate exercise, and in models for conventionality.

In summary, the application of a theory-derived, systematic approach to developmental change in adolescent health-enhancing behavior yielded a significant account based on changes in proximal and distal psychosocial and behavioral protective and risk factors. There is considerable generality of the developmental account across the two health-enhancing behaviors, across sex and grade cohort, and, of especial importance, across adolescent samples from two such different societies.

## DISCUSSION

The social-psychological explanatory framework employed in the present study has been helpful in advancing understanding of variation in adolescent health-enhancing behaviors. A substantial account of that variation—both cross-sectional and developmental—was provided by a systematic set of protective- and risk-factor measures, and the account was shown to have considerable generality across samples from the People's Republic of China and the United States. The articulation, in the explanatory framework, of protective and risk factors that are psychosocial and behavioral, proximal and distal, and at both the individual and social-contextual level has provided a more differentiated and more comprehensive account of adolescent health behavior.

In both the cross-sectional and the longitudinal analyses, the proximal, individual-level protection measures of value on health and of perceived effects of unhealthy diet were important in both country samples; the proximal, social contextual protection measures of models for healthy diet and adequate exercise were also important. These findings are consistent with much other research; because the measures are proximal, such findings are not surprising. Of greater interest, theoretically, are the findings for the distal measures: the distal contextual protection measure of models for conventionality was significant in the China sample, and friends controls for unconventionality was important in both country samples; the distal, individual-level risk measure of low self-esteem was important in both countries; and the distal, individual-level index of prosocial behavior, a protection measure, was also important in both country samples. These findings for the distal measures strengthen the claim for their explanatory role in accounting for variation in adolescent health-enhancing behavior.

The important role that the MPSBI played in the account of both criterion behavior measures warrants special comment. What it makes apparent is that health-enhancing behaviors are not an isolated or unique aspect of an adolescent's repertoire; rather, those behaviors are significantly associated with other behaviors, namely, prosocial behaviors, including achieving academically in school, spending time doing things with family, taking part in school and community activities, and attending religious services. These findings suggest that health-enhancing behaviors are part of a larger adolescent lifestyle, one that reflects a generalized conventional orientation. That characterization of the larger lifestyle is supported by the significant regression coefficients for the measures of models for conventionality (China only) and of friends controls for unconventionality in both country samples when the criterion measure was attention to healthy eating.

Several of the distal, individual-level psychosocial risk measures, measures of psychosocial vulnerability in the explanatory framework—depressive mood, felt stress, low self-esteem, low expectations—had significant regression weights in Table 2 for one or both criterion measures in one or both of the country samples. Psychosocial vulnerability, especially as reflected here in depressive mood and low self-esteem, seems important to consider as a correlate of or influence on health-enhancing behavior in both societies and for both sexes.

In light of the conceptual differentiation of protective and risk factors relied upon in this research, it was of interest to examine their relative contributions to the explanatory account. The set of protective factors accounted for a considerably larger portion of unique variance than did the set of risk factors in both country samples. While this finding undoubtedly reflects, at least in part, the larger number of protective-factor predictors, it is also consonant with our earlier findings that protection matters more than risk when the criterion is a positive or prosocial behavior, a reflection of its promotive property.

The availability of data on adolescents from a society as different from the United States as the People's Republic of China is provided a rare opportunity to examine the reach or generality of the explanatory framework. Beyond such societal-level differences as, for example, the one-child family policy in China, its socialist economic system, its status as a developing country, etc., there were also mean differences in prevalence of the two criterion measures, attention to healthy eating (China higher) and regular exercise (U.S. girls higher than girls in China). Such differences permitted a rather stringent test of the generality of the explanatory framework; notwithstanding such differences, the explanatory model proved to be apposite for both country samples. The amount of variance accounted for by the protective factors and risk factors in both country samples was similar; perhaps more important, the pattern of significant regression coefficients was similar for both country samples, with some exceptions as noted above. Within-country generality was also established across sex and grade cohorts by the lack of significant interactions of the predictors with either of those attributes. Such findings make clear that, while differences may obtain between groups on background measures and in mean levels or prevalence, those differences are merely *descriptive*. Despite such descriptive, ''surface'' differences, the same explanatory model may apply equally well at the analytic, underlying, or ''causal'' level of analysis (Jessor, 2008).

The finding that most of the same protective and risk measures that explained cross-sectional variation in health-related behaviors were also the predictors that accounted for developmental change (largely decline) in those behaviors is noteworthy. Change in those predictors over the 2-year interval was shown to be associated with change in both criterion measures, at least at this stage of the developmental trajectory when the cohorts were moving from early adolescence (13–15) to mid-adolescence (15–17). Whether that would apply to a later stage of developmental change awaits further research. For this developmental stage, however, the identification of attributes, change in which is associated with change in health-related behaviors, is information that has relevance for the design of intervention efforts to promote healthy behavior.

There are, obviously, shortcomings in the present research that limit the inferences that can be drawn as well as constrain the applicability of the findings. Foremost at the explanatory level is the fact that the model that was operationalized was somewhat truncated. Psychosocial risk was not as exhaustively assessed in the regression model as was psychosocial protection, and it is difficult to estimate how different the outcome would be either in magnitude or pattern of the explanatory account had those measures been included. The fact that all of the measures of protection and risk are based on self-report is another obvious limitation, especially for the social context measures that derived from the adolescent

being placed in the role of quasi-ethnographer. Some reassurance in this regard stems from the literature on self-report of dietary behavior and physical activity indicating that self-reports are a reliable and valid indicator of those behaviors (Berkey et al., 2000; Booth, Okely, Chey, & Bauman, 2001, 2002; Pate et al., 2009; Prochaska, Sallis, & Rupp, 2001; Rockett & Colditz, 1997; Sallis & Saelens, 2000). In addition, the evidence in this study that the adolescent reports about the social context added unique variance to the explanatory account earns them an added degree of credibility. Finally, the inability to establish moderator effects of protection on risk, that is, protection-by-risk interactions, in the present study is a departure from previous findings with both problem and health behaviors. It may be due to the limited assessment of risk factors; it may be due to the employment of somewhat different protection and risk measures in the current analyses; it may be due to the use, for the first time, of the later wave of adolescent data, Wave 2, when the adolescents were older, having reached mid-adolescence; or it may be due to inclusion, for the first time, of measures of behavioral protection and risk in the predictor set.

These limitations notwithstanding, the findings in the present study have enlarged understanding of adolescent involvement in health-enhancing behavior. They have identified some of the key psychosocial and behavioral variables in the adolescent and in the adolescent's social context that are associated with involvement in health-enhancing behavior, and they have provided an account of the development of such behaviors across the early-to-mid-adolescent life stage. Such findings constitute the contribution of theory-guided inquiry about adolescent health-related behavior.

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