Epidemiology and Prevention

A Prospective Study of Positive Early-Life Psychosocial Factors and Favorable Cardiovascular Risk in Adulthood

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Background—The American Heart Association’s national goals for cardiovascular health promotion emphasize that cardiovascular risk originates early in life, but little is known about childhood factors that may increase the likelihood of having a favorable cardiovascular risk (FCR) in adulthood. We examined the prospective association between positive childhood factors and the likelihood of midlife FCR. We also considered pathways through which childhood factors may influence FCR.

Methods and Results—We studied 415 adults (mean age=42.2 years) of the Collaborative Perinatal Project, a national cohort initiated in 1959 to 1966. We examined 3 positive childhood factors assessed at age 7 years: attention regulation (ability to stay focused), cognitive ability, and positive home environment. Of these adults, 10.6% had FCR in midlife. Adjusting for demographics and childhood cardiovascular health, a 1-unit increase in childhood attention regulation, cognitive ability, and positive home environment was associated with 2.4 (95% confidence interval, 1.1–4.7), 1.8 (95% confidence interval, 1.1–2.9), and 1.3 (95% confidence interval, 1.1–1.6) higher respective odds of having midlife FCR. The association with childhood attention regulation was maintained when accounting for adulthood factors; education and diet in part explained the associations with childhood cognitive ability and home environment. The effect of each attribute was additive as those with high levels of each childhood factor had 4.3 higher odds (95% confidence interval, 1.01–18.2) of midlife FCR in comparison with those low in all factors.

Conclusions—Positive childhood psychosocial factors may promote healthy adult cardiovascular functioning. Primordial prevention efforts aimed at preventing the development of cardiovascular risk should consider building on childhood psychosocial resources. (Circulation. 2013;127:905-912.)

Key words: favorable cardiovascular risk ■ life course ■ psychosocial factors

Children are typically born with many of the requisite components of ideal cardiovascular health. They generally have healthy blood pressure, lipid and glucose levels, they do not smoke and have the potential for developing an ideal body weight, healthy dietary and physical activity practices. That said, numerous studies have indicated that loss of cardiovascular health often begins in childhood and progresses over the life course. Those who reach midlife with a favorable constellation of cardiovascular risk factors (eg, systolic blood pressure ≤120 mm Hg, diastolic blood pressure ≤80 mm Hg, total cholesterol <200 mg/dL, body mass index <25 kg/m², nonsmoker, no diabetes) experience significantly lower lifetime remaining risk for developing cardiovascular disease (CVD) and have increased longevity relative to individuals with unfavorable levels of such factors. However, the vast majority of middle-aged US adults have poor cardiovascular health, and, once risk factors are elevated, they are difficult to ameliorate. As such, primordial prevention of CVD, or preventing the development of CVD risk factors in the first place, has increasingly become of interest to cardiovascular epidemiologists and clinicians to more effectively reduce the burden of CVD in the population. Because many CVD risk factors such as obesity and atherosclerosis develop early in life, childhood is a life stage particularly amenable to primordial prevention efforts because cardiovascular risk is not yet well established. Moreover, childhood may serve as a sensitive period of development whereby exposures occurring early in life, including health-promoting experiences, may impact physical health over the life course. Therefore, the identification of childhood factors associated with adult favorable cardiovascular risk (FCR) may be of great utility in furthering primordial prevention work.

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Significant public health efforts have focused on the reduction and prevention of CVD risk factors during childhood (eg,
reduction in sedentary behavior). Although important and necessary, this approach often overlooks the role of positive factors in childhood that may actively promote health. Positive factors do not simply reflect the absence of risk factors, but instead are independent attributes or assets that enhance health and resilience over time. Recent work has identified several early-life psychosocial factors that may influence cardiovascular health over the life course, including self-regulation (the ability to manage behavior, emotion, attention, and social interactions), cognitive ability, and aspects of the home environment. Cognitive ability and the capacity to self-regulate attributes that emerge in childhood and remain stable over the life course. They are hypothesized to influence life-long health by facilitating education attainment, effective problem solving, communication, memory, sense of control, and the ability to cope with stressful situations. Although less frequently studied than childhood adversity, the positive features of the childhood home environment are hypothesized to promote resiliency over the life course through a variety of pathways including the promotion of more resilient biology (eg, increased expression of oxytocin in response to warm parenting) and the development of effective coping and emotion regulation strategies. Following a life-course accumulation model, the benefits of positive childhood attributes may cumulatively build over time, thereby safeguarding and promoting cardiovascular health in adulthood, although this hypothesis has not yet been tested. Thus, this study was designed to test the hypothesis that positive childhood psychosocial factors would be associated with more FCR in adulthood.

The greatest insight into potential targets for primordial prevention may be gained by rigorous control for potential confounding, including accounting for childhood cardiovascular health (eg, blood pressure, diabetes mellitus, body mass index), and considering likely pathways through which positive early-life psychosocial factors may contribute to adult cardiovascular health. Therefore, the aim of the current study is to examine the prospective association of 3 positive childhood psychosocial factors (self-regulation, cognitive ability, and positive home environment) with the likelihood of having FCR 35 years later, while rigorously controlling for childhood cardiovascular health and other potential confounders. A secondary aim is to examine potential pathways (eg, diet, physical activity) from adulthood that might help explain the associations. Although there has been much recent interest in defining healthy cardiovascular functioning and identifying the life-course predictors of FCR in adulthood, the role of psychosocial factors in the development of healthy cardiovascular functioning has not been evaluated. To our knowledge, this is the first study to examine prospectively the association between multiple positive childhood psychosocial factors with FCR in adulthood.

Methods

Sample

The Figure displays a flow chart describing how the study sample was selected. The sample comes from offspring of participants of the Collaborative Perinatal Project. Pregnant women enrolled in the Collaborative Perinatal Project between 1959 and 1966 and their offspring were regularly assessed from birth to 7 years. The New England Family Study is a set of follow-up studies of the now adult offspring from the New England sites. Details on selection of the current sample are described elsewhere. In brief, our sample includes New England Family Study participants involved in 2 adult follow-up studies: first, in the Brown-Harvard Transdisciplinary Tobacco Use Research Center and, subsequently, in the EdHealth study that included 618 Transdisciplinary Tobacco Use Research Center participants, selected with preference for racial/ethnic minorities and those with low and high levels of education as required by the aims of the project. Of the 618 individuals interviewed (69% response rate), 42 who were not interviewed in person (and did not complete physiological assessments) were excluded, resulting in 576 eligible participants. Of these, 430 (75%) participated in the clinical assessment, where a blood sample and anthropomorphic measurements were obtained by trained study personnel. Of these, 415 had complete outcome data and were included in the analysis. Missing covariate information was imputed for 27 of these participants (6.5%). Because results were highly similar when using imputed and nonimputed data sets, we present the imputed results here. Human subjects committees at Brown University and Harvard School of Public Health approved the study protocol. All participants provided informed consent.

Measures

**Favorable Cardiovascular Risk**

Consistent with other work in this area, FCR was defined as meeting the following criteria in midlife: systolic blood pressure ≤120 mm Hg, diastolic blood pressure ≤80 mm Hg, not taking antihypertensive medication, total cholesterol <200 mg/dL, not taking cholesterol-lowering medication, body mass index <25 kg/m², not having diabetes mellitus, and nonsmoker. FCR was dichotomized according to whether or not participants met all criteria (yes/no).

Total cholesterol was measured in nonfasting plasma samples at CERLab (Harvard Medical School) by using a Hitachi 911 analyzer and participating in the Centers for Disease Control and Prevention/National Heart, Lung, and Blood Institute Lipid Standardization Program. Total cholesterol (coefficient of variation=1.7%) was measured enzymatically as described elsewhere. Five blood pressure readings were obtained over 1-minute intervals after 5 minutes of rest, in the right arm at heart level, with the use of automated blood pressure monitors (VSM MedTech BpTru, Coquitlam, BC, Canada), which have good validity and reliability in comparison with auscultation. Systolic and diastolic blood pressure values were calculated as the mean of the lowest 5 readings, excluding the first. Body mass index (BMI) was calculated as the ratio of weight in kilograms to the square of height in meters (kg/m²) by the use height and weight measurements obtained by study personnel. Current smoker, antihypertensive medication use, cholesterol-lowering medication use, and the presence of diabetes mellitus (as told by doctor/health professional; excluding gestational diabetes) were each self-reported (yes/no).

**Positive Childhood Psychosocial Factors**

Attention regulation capacity, cognitive ability, and positive home environment were each assessed during childhood.

Attention regulation capacity is a specific form of self-regulation that reflects the child’s ability to stay focused on a task, persevere, and persist in problem solving. At the age 7 year study visit, trained psychologists administered a 2-hour battery of cognitive, sensory, and motor tests to the child without the mother present and rated the child on 15 behaviors observed during those tests. A reliable measure of attention regulation capacity was derived from these behaviors (α=0.82). Past work has documented the validity of this scale against a contemporary gold standard for assessing child behavior (Achenbach Child Behavior Checklist). Attention regulation capacity is negatively correlated with internalizing, externalizing, and attention problems, as assessed with the Achenbach Child Behavior Checklist, and has been found to predict emotional functioning in adulthood. Scores were standardized to have a mean of 0 and standard deviation of 1. Scores above the mean indicate better attention regulation capacity.

Childhood cognitive ability reflects the ability to reason, think abstractly, comprehend ideas, and learn from experience. Cognitive ability was assessed during the age 7 study visit with the use of the Wechsler Intelligence Scale for Children, from which an estimate of
IQ was derived. In the general population, the mean IQ is 100 with a standard deviation of 15. Scores above the mean indicate greater cognitive ability. For ease of interpretation, logistic regression coefficients for childhood IQ were multiplied by 15 and then exponentiated to obtain odds ratios that correspond to a 15-point (or 1 standard deviation in the general population) advantage in childhood cognitive performance.

Childhood home environment was a composite measure that assessed positive emotional, social, and physical aspects of the home from birth to age 7 years. Home environment was assessed as a composite, because the emotional, social, and physical aspects of home life are not experienced in isolation from one another and may cumulatively affect FCR. With the use of composite variable construction methods common in childhood adversity research, the positive home environment score was a sum of the number of positive emotional, social, and physical aspects of the home environment. Because no component was hypothesized to be more important than another, parts of the composite were not additionally weighted, resulting in a simple and conservative summary of the cumulative experience of positive features of the home environment. The emotional domain was assessed via maternal parenting behaviors. Mother and child interactions were observed when the child was 8 months of age by study psychologists during standardized cognitive and developmental testing of the infant. Several maternal parenting behaviors were observed and scored as present or not (1/0) including the expression of affection, acceptance of the child, positive physical handling, guidance of the child, and responsiveness to the child's needs. Individual parenting behaviors were not necessarily positive experiences themselves, but together represent a parenting style that may have implications for FCR later in life. Therefore, a summary maternal parenting score was subsequently derived, with higher scores indicating greater tendency toward warm and responsive parenting behaviors (range, 0–5; α=0.68). Experiencing warm and responsive parenting in infancy is associated with better psychological functioning in adulthood, including greater optimism (t(340)=2.27, P=0.02), marginally fewer depressive symptoms (t(344)=1.89, P=0.08), greater agreeableness (t(343)=2.45, P=0.01), and marginally greater emotional stability (t(343)=1.63, P=0.10) in this sample.

The overall emotional domain score was then dichotomized as high (5) and low (<5) based on the available distribution for inclusion in the home environment composite (1=high; range, 0–1). The social environment domain was assessed with a summary score (range, 0–4) based on the presence or absence (1/0) of the following characteristics: 2-parent household at age 7, never living in poverty, high parental education (more than high school; according to the highest level of education in the household as reported by either parent), and father consistently employed during the child’s first 7 years of life. The physical environment domain was assessed according to a sum score (range, 0–2) across presence or absence (1/0) of residential stability (no moves over 7 years) and not living in a crowded dwelling at age 7 (<1.5 people per room). To obtain the summary positive home environment variable, 1 point was given to each emotional, social, and physical environment domain item, and overall sum scores were derived (range, 0–7). Higher scores indicate a more positive childhood home environment.

In addition, we examined the potential additive effects of having high levels of 1, 2, and all 3 positive childhood factors (attention regulation, cognitive ability, and positive home environment). We assessed this by creating a dichotomous variable (high/low) for each factor followed by a composite 4-category variable: high for all 3 factors, high for 2 factors, high for 1 factor, high for 0 factors. According to previous work with childhood cognitive ability scores, high cognitive ability was defined as those who had IQ scores of 115 or higher (ie, at least 1 standard deviation above the mean). High attention regulation and high positive home environment reflect those in the top tertile of the distributions. These cut points are based on the available distribution of scores within this sample and represent those with a high degree of childhood psychosocial assets hypothesized to be relevant for FCR.

Covariates
Demographic, childhood, and adulthood covariates were selected based on their potential for either confounding or mediating the associations between childhood psychosocial assets and FCR in adulthood. Self-reported demographics that could potentially confound the
associations included age at the midlife assessment, race (white/not white), and sex. A site variable (Boston, Massachusetts/Providence, Rhode Island) was included in all models to adjust for potential differences between study locations.

Several potential confounding variables from childhood were examined including socioeconomic status (index reflecting the education, occupation, and income of the head of household when the child was 7 years of age, scores range from 90 to 100(high)), small for gestational age (birthweight = <10th percentile for gestational age at delivery), presence of a chronic physical health condition during childhood, and childhood cardiovascular health. Childhood chronic physical health conditions were derived from physical examinations by Collaborative Perinatal Project pediatricians at ages 1 and 7 years, obtained via mothers’ reports at each visit, and extracted from medical records at ages 1 and 7. We used a summary score of the number of chronic physical health conditions (including abnormalities of the liver, cardiovascular conditions, hematologic conditions, eg, anemia, lower respiratory tract abnormality (eg, asthma), neoplastic disease, neurological abnormality, and prolonged/recurrent hospitalization), coded as 0 or ≥1 conditions.

Childhood cardiovascular health was assessed according to BMI, blood pressure, and the presence of diabetes mellitus at age 7 years. BMI was calculated as kg/m² by using the height and weight obtained by trained study personnel using standard anthropometry equipment for the time. Child systolic and diastolic blood pressure (mm Hg) was measured by a study pediatrician. The presence of diabetes mellitus was assessed by a study pediatrician. However, because only 1 child was suspected to have diabetes mellitus and no children received a diagnosis of diabetes mellitus, we did not include this variable in the analysis.

Adulthood potential pathway variables were self-reported. Depressive symptoms were assessed via the validated Center for Epidemiological Studies of Depression scale (α=0.88), with higher scores indicating more depressive symptoms. Education attainment was the total years of education completed. Physical activity was assessed with a single item that asked whether or not participants engaged in vigorous physical activity in a typical week. Western and prudent dietary patterns were assessed with a 25-item Food Frequency Questionnaire. 3,4 Western diets were characterized by higher consumption of red meats, refined grains, high-fat dairy products, and sugar-sweetened beverages. Prudent diets were characterized by higher consumption of fruits, vegetables, legumes, whole grains, fish, and poultry.

Analysis

We used multiple imputation procedures (PROC MI, PROC MIANALYZE; SAS Institute Inc) to impute missing values on covariates and pool estimates from 5 imputed data sets.6,13 Those excluded from the analytic sample because of missing outcome data (eg, did not complete the clinical assessment; n=203) were compared with those analyzed (n=415) in terms of childhood psychosocial factors, child health (small for gestational age, chronic condition, blood pressure, age 7 BMI), age, race, sex, adult BMI, and education attainment via χ² and independent t tests. Bivariate associations for participant characteristics and positive childhood factors were assessed with Pearson correlations. Bivariate associations between FCR and study variables were assessed with independent t and χ² tests. Multiple logistic regression models assessed the associations of each positive childhood psychosocial factor and FCR in adulthood, and the additive effect of having high levels of 1, 2, or 3 positive childhood factors, as well. Demographic and childhood covariates were considered as potential confounders, whereas covariates from adulthood were considered as possible pathways through which positive childhood psychosocial factors might influence the development of FCR. Home environment models do not adjust for childhood socioeconomic status, because socioeconomic factors in part make up the home environment variable. Evidence that adulthood factors may serve as pathways was assessed first by including all adulthood factors in the models as a single block and examining whether the coefficient for the childhood psychosocial factor was attenuated.8,9 When the childhood coefficients were attenuated, Sobel tests adapted for logistic regression20 were conducted for each adulthood factor to determine whether the mediated effect attributable to that factor was significantly different from zero. Finally, to evaluate which components of the FCR profile may be most strongly related to the childhood psychosocial factors, logistic regression models were fit for each childhood factor with components of the FCR profile as separate outcomes. Statistical significance was determined by 95% confidence intervals and P values of <0.05.

Results

Descriptive Statistics

There were no significant differences in positive childhood psychosocial factors, childhood health, adult BMI, education attainment, or sex among those who were excluded (n=203) and included in the study (n=415) (all P>0.05), although the excluded were older by 0.85 years (t(616)=−5.5, P<0.001) and more likely to be white (χ²=4.4, P<0.05). Table 1 lists sample characteristics and bivariate associations of these characteristics with the positive childhood psychosocial factors. Participants were on average 42.2 years of age at follow-up, 80.5% white, and 59% female. The prevalence of adult FCR was 10.6%, which is within the range of what other studies have observed.3,5 Positive childhood psychosocial factors were positively correlated with higher childhood socioeconomic status (all P<0.001) and higher educational attainment (all P<0.10), and negatively correlated with adult depressive symptoms (all P<0.05). Childhood psychosocial factors were correlated with one another (all P<0.05), but the magnitude of the associations were small to moderate (r ranged from 0.11 to 0.41) indicating limited overlap in constructs. In comparison with those who did not have FCR in adulthood, those with FCR were significantly younger at follow-up (t(413)=2.6, P=0.01), more likely to be female (χ²=15.2, P<0.001), had higher socioeconomic status as children (t(398)=−2.1, P=0.04), and had higher education attainment (t(410)=−2.4, P=0.02), fewer depressive symptoms (t(413)=−3.5, P=0.008), and greater adherence to a prudent diet (t(402)=2.9, P=0.004) versus a western diet (t(402)=3.3, P=0.007) as adults.

Positive Childhood Psychosocial Factors and Favorable Cardiovascular Risk in Adulthood

Positive childhood psychosocial factors were significantly associated with FCR in adulthood, controlling for demographic and childhood covariates (Table 2). The odds ratios (ORs) for adult FCR associated with a 1 standard deviation increase in childhood attention regulation capacity, a 15-point increase in childhood IQ score, and a 1-unit increase in positive home environment score were 2.4 (95% confidence interval [CI], 1.1–4.7), 1.8 (95% CI, 1.1–2.9), and 1.3 (95% CI, 1.1–1.6), respectively.

Five percent of participants had high levels of all 3 positive childhood psychosocial factors. Relative to individuals with low levels of all 3 factors, those who were high in all 3 assets had significantly higher odds (OR, 4.3; 95% CI, 1.01–18.2) of FCR in adulthood, and a nonsignificant trend was evident among those high in 2 childhood factors (OR, 2.5; 95% CI, 0.94–6.7; P<0.10), controlling for demographic and childhood covariates (Table 2).

Childhood attention regulation capacity remained independently associated with FCR when adjusting for adulthood pathways factors (Table 2). In contrast, controlling for adulthood factors attenuated associations for FCR with cognitive ability and home environment, suggesting that adulthood factors may be on the pathway (Table 2).

Results from the...
Sobel tests indicated that no single adulthood factor mediated the association between cognitive ability and FCR, although trends were evident for fewer depressive symptoms ($P=0.07$), higher education attainment ($P=0.15$), and greater adherence to a prudent diet ($P=0.12$). For home environment, the observed mediated effect was significantly different from zero for higher education attainment ($P=0.02$) and fewer depressive symptoms ($P=0.05$), and a trend was evident for greater adherence to a prudent diet ($P=0.13$).

Associations of positive childhood factors with component parts of the FCR profile are displayed in Table 3. Associations of attention regulation, cognitive ability, and home environment with each FCR component were typically in the expected directions, although the confidence intervals overlapped the referent category for most factors. Attention regulation was significantly associated with not using antihypertensive medication (OR, 1.4; 95% CI, 1.0–2.0); home environment was associated with low diastolic blood pressure (OR, 1.2; 95% CI, 1.0–1.4), not having diabetes mellitus (OR, 1.5; 95% CI, 1.0–2.1), and not smoking (OR, 1.3; 95% CI, 1.1–1.5). Overall, findings suggest that attention regulation, cognitive ability, and home environment are modestly associated with each FCR component. Thus, a modest effect on each factor likely led to significant associations of the positive childhood factors with the overall FCR score, which combines all factors into a single score.

**Discussion**

Results from this study indicate that positive childhood psychosocial factors may promote cardiovascular health in midlife. Specifically, higher levels of childhood attention regulation capacity, cognitive ability, and positive home environment

### Table 1. Characteristics of Study Participants and Correlations With Positive Childhood Psychosocial Factors

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean (SD or %)</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=415</td>
<td>Attention Regulation</td>
</tr>
<tr>
<td>Demographics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, y</td>
<td>42.2 (1.8)</td>
<td>0.02</td>
</tr>
<tr>
<td>Race (not white)</td>
<td>19.5</td>
<td>-0.10*</td>
</tr>
<tr>
<td>Sex (male)</td>
<td>41.0</td>
<td>-0.03</td>
</tr>
<tr>
<td>Childhood covariates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socioeconomic status index</td>
<td>54.0 (23.0)</td>
<td>0.14‡</td>
</tr>
<tr>
<td>Born small for gestational age</td>
<td>10.2</td>
<td>-0.01</td>
</tr>
<tr>
<td>Body mass index, kg/m²</td>
<td>16.1 (1.6)</td>
<td>-0.01</td>
</tr>
<tr>
<td>Chronic condition</td>
<td>18.3</td>
<td>0.03</td>
</tr>
<tr>
<td>Systolic blood pressure, mm Hg</td>
<td>104.4 (10.9)</td>
<td>-0.04</td>
</tr>
<tr>
<td>Diastolic blood pressure, mm Hg</td>
<td>60.4 (10.4)</td>
<td>0.02</td>
</tr>
<tr>
<td>Adulthood covariates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education attainment, y</td>
<td>13.6 (2.6)</td>
<td>0.09*</td>
</tr>
<tr>
<td>Depressive symptoms</td>
<td>1.59 (0.56)</td>
<td>-0.11†</td>
</tr>
<tr>
<td>Vigorous physical activity</td>
<td>73.2</td>
<td>0.06</td>
</tr>
<tr>
<td>Western diet score ($z$)</td>
<td>0.03 (1.1)</td>
<td>-0.01</td>
</tr>
<tr>
<td>Prudent diet score ($z$)</td>
<td>-0.01 (0.69)</td>
<td>0.07</td>
</tr>
</tbody>
</table>

*P<0.10; †P<0.05; ‡P<0.01; §P<0.001.

### Table 2. Odds Ratios (95% Confidence Intervals) for the Associations of Positive Childhood Psychosocial Factors With Favorable Cardiovascular Risk in Adulthood

<table>
<thead>
<tr>
<th>Childhood Factor</th>
<th>Unadjusted</th>
<th>+ Demographic*</th>
<th>+ Childhood†</th>
<th>+ Pathways‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention regulation</td>
<td>2.3 (1.2–4.6)</td>
<td>2.4 (1.2–4.9)</td>
<td>2.4 (1.1–4.7)</td>
<td>2.0 (1.0–3.9)</td>
</tr>
<tr>
<td>Cognitive ability</td>
<td>1.6 (1.1–2.3)</td>
<td>1.7 (1.1–2.7)</td>
<td>1.8 (1.1–2.9)</td>
<td>1.5 (0.90–2.6)</td>
</tr>
<tr>
<td>Positive home environment</td>
<td>1.3 (1.1–1.6)</td>
<td>1.3 (1.1–1.6)</td>
<td>1.3 (1.1–1.6)</td>
<td>1.2 (0.90–1.5)</td>
</tr>
<tr>
<td>Additive effect of positive factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High in all factors (n=19)</td>
<td>2.6 (1.5–4.5)</td>
<td>4.3 (1.1–17.4)</td>
<td>4.3 (1.0–18.2)</td>
<td>1.9 (0.42–9.1)</td>
</tr>
<tr>
<td>High in 2 factors (n=63)</td>
<td>1.6 (1.1–2.4)</td>
<td>2.4 (0.93–6.4)</td>
<td>2.5 (0.94–6.7)</td>
<td>2.0 (0.68–6.0)</td>
</tr>
<tr>
<td>High in 1 factor (n=206)</td>
<td>0.97 (0.69–1.4)</td>
<td>1.0 (0.49–2.1)</td>
<td>0.98 (0.46–2.1)</td>
<td>0.81 (0.38–1.8)</td>
</tr>
<tr>
<td>High in 0 factors (n=127)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Odds ratios are interpreted as the odds of having favorable cardiovascular risk in adulthood per unit change in childhood psychosocial factors.

*Demographic model adjusts for site, age, and race.

†Childhood model adjusts for demographic and childhood factors (born small for gestational age, chronic conditions, blood pressure, body mass index, socioeconomic status). Home environment models do not adjust for socioeconomic status because socioeconomic factors, in part, make up the variable.

‡Pathways model adjusts for demographic, childhood, and adulthood factors (education attainment, depressive symptoms, physical activity, and diet).
were associated with a greater likelihood of FCR in adulthood, as characterized by healthy levels of blood pressure, cholesterol, and BMI, and cardiovascular-related medication use, smoking, and diabetes status, as well. The cardiovascular benefit of each factor appears to be additive because the overall effect of having high levels of each factor is large: those with high levels of all assets had >4-fold increased odds of FCR in adulthood. We illustrate that, although possessing any of the positive factors in childhood may benefit cardiovascular health, the effect of having multiple psychosocial assets may cumulatively build to protect cardiovascular health. These findings are novel because this study is the first to examine positive early-life psychosocial determinants of a cardiovascular health profile indicative of low remaining lifetime risk of developing CVD and increased longevity.2,3,6

Previous work has suggested that these childhood factors are associated with reduced risk of CVD in adulthood. For example, a previous report from our team among 356 men and women found childhood attention regulation capacity measured at age 7 was associated with fewer adult physical health conditions, including heart disease, diabetes mellitus, and stroke, 30 years later.38 In another study among 1122 adult men (mean age=60.3 years), high self-regulation was associated with 20% reduced risk of incident coronary heart disease over 13 years of follow-up.13 Similarly, several studies suggest that low childhood cognitive ability (indexed by IQ score) is associated with increased CVD risk in adulthood.27,39 For example, in a study of 938 Scottish men and women, a 1 standard deviation lower IQ score at age 10 was associated with a 19% increase in CVD-related hospital admissions and deaths over 25 years of follow-up.39 Also, although few studies have considered the association between a positive childhood home environment and cardiovascular health, much work has considered adversities in the home environment and specific parenting behaviors in association with CVD risk.2,11,18,40 For example, among 1205 participants of the Midlife in the United States Study (MIDUS), retrospective accounts of high levels of maternal nurturance buffered the deleterious effects of growing up in poverty on metabolic syndrome risk in midlife.11 Similarly, among 3554 participants of the Coronary Artery Risk Development in Young Adults (CARDIA) study, a retrospective account of adversities in the childhood family psychosocial environment (eg, child was physically abused, lacking affection, lived with a substance abuser) was associated with higher 10-year coronary heart disease risk in adulthood as estimated by the Framingham algorithm.40 Taken together, these studies suggest that childhood attention regulation, cognitive ability, and aspects of the home environment may contribute to adult CVD risk. Our study extends this work to look at protective childhood factors for maintaining and promoting cardiovascular health over the life course.

Results from the pathways models suggest that the associations between childhood cognitive ability and positive home environment with FCR may be working through adulthood social and behavioral factors, including fewer depressive symptoms, higher education attainment, and healthier dietary patterns. As such, consistent with a life-course accumulation model, the benefits of higher childhood cognitive ability and positive home environment may cumulatively protect cardiovascular health by way of reducing or preventing social and behavioral risk factors for CVD. This finding is also consistent with recent prospective work among 3154 CARDIA participants whereby healthy lifestyle factors (eg, healthy diet, physical activity, no smoking) originating in childhood and continuing through early adulthood contributed to the development of FCR in midlife.15 Early-life cognitive ability and positive home environments may help to set up such healthy lifestyle trajectories that cumulatively promote cardiovascular health in adulthood.

We also found childhood attention regulation to be independently associated with adult FCR. Attention regulation capacity is a higher-order feature of self-regulation and executive functioning10 that pervades many aspects of functioning relevant for cardiovascular health (eg, maintaining healthy diets and exercise regimens, attending to health messages, navigation of the healthcare system). Moreover, effective self-regulation may reduce the intensity and duration of sympathetic nervous system and hypothalamic-pituitary-adrenal activation attributable to stress and negative emotions that could otherwise have deleterious effects on cardiovascular functioning over time.41 Effective self-regulation may therefore help protect cardiovascular health by way of reducing or preventing such physiological wear-and-tear over the life course. Future work is advised to map such potential linkages explicitly.

This study has a number of strengths. First, the measures of childhood psychosocial factors were assessed 35 years before

Table 3. Odds ratios (95% Confidence Intervals) for the Associations Between Positive Childhood Psychosocial Factors and Component Parts of the Favorable Cardiovascular Risk Profile

<table>
<thead>
<tr>
<th>Favorable cardiovascular risk component</th>
<th>%</th>
<th>Attention Regulation</th>
<th>Cognitive Ability</th>
<th>Home Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic blood pressure &lt;140 mm Hg</td>
<td>69.6</td>
<td>1.0 (0.77–1.3)</td>
<td>0.89 (0.67–1.2)</td>
<td>1.1 (0.93–1.3)</td>
</tr>
<tr>
<td>Diastolic blood pressure &lt;80 mm Hg</td>
<td>68.0</td>
<td>1.1 (0.86–1.4)</td>
<td>0.87 (0.66–1.1)</td>
<td>1.2 (1.0–1.4)</td>
</tr>
<tr>
<td>Not using antihypertensive medication</td>
<td>89.4</td>
<td>1.4 (1.0–2.0)</td>
<td>1.2 (0.78–1.8)</td>
<td>1.2 (0.92–1.4)</td>
</tr>
<tr>
<td>Total cholesterol &lt;200 mg/dL</td>
<td>56.8</td>
<td>1.2 (0.93–1.5)</td>
<td>1.1 (0.88–1.5)</td>
<td>0.98 (0.85–1.1)</td>
</tr>
<tr>
<td>Not using cholesterol-lowering medication</td>
<td>92.5</td>
<td>1.2 (0.74–1.8)</td>
<td>1.2 (0.78–2.0)</td>
<td>0.97 (0.74–1.3)</td>
</tr>
<tr>
<td>Body mass index &lt;25 kg/m²</td>
<td>29.4</td>
<td>1.2 (0.90–1.6)</td>
<td>1.1 (0.86–1.5)</td>
<td>1.0 (0.89–1.2)</td>
</tr>
<tr>
<td>Nondiabetic</td>
<td>96.1</td>
<td>1.4 (0.85–2.3)</td>
<td>1.3 (0.68–2.4)</td>
<td>1.5 (1.0–2.1)</td>
</tr>
<tr>
<td>Nonsmoker</td>
<td>72.8</td>
<td>1.1 (0.67–1.1)</td>
<td>1.2 (0.87–1.6)</td>
<td>1.3 (1.1–1.5)</td>
</tr>
</tbody>
</table>

Odds ratios are interpreted as the odds of having the favorable cardiovascular risk component in adulthood per unit change in childhood psychosocial factors, adjusted for demographic (age, race, sex, and site) and childhood (born small for gestational age, chronic conditions, blood pressure, body mass index, socioeconomic status) covariates. Home environment models do not adjust for socioeconomic status because socioeconomic factors, in part, comprise the variable.
that adult assessments and were largely based on psychologists’ observations of maternal and childhood behaviors and standardized testing. Also, the outcome measure incorporated objectively measured biomarkers of CVD. Moreover, a broad range of covariates from across the life course were assessed, including multiple measures of childhood cardiovascular health, thereby addressing concerns of previous confounding by early-life CVD risk. This study also has some limitations. First, unmeasured confounding may remain (eg, genetics) and should be assessed in future work. Also, when Collaborative Perinatal Project went into the field in the 1950s, there were no population-based research tools to assess parenting behavior or home environment. Although our measures perform moderately well, contemporary measures may provide more accurate assessments. In addition, generalizability may be somewhat limited, because participants were selected from a New England Family Study subsample based on certain demographic characteristics per the aims of the project. However, the prevalence of FCR we observed is comparable to rates found in similar population-based studies, which helps mitigate some concerns about generalizability. Also, although loss to follow-up due to death was minimal in this study, exclusion of those who died could yield a healthier sample, which could lead to overestimated associations. Finally, outcome and pathway variables were assessed concurrently making tests of mediation less robust. These limitations notwithstanding, we note that this study is among the first to examine the associations of multiple positive childhood psychosocial factors with FCR in adulthood. As such, we demonstrate that the accumulation of psychosocial assets beginning early in life may help protect cardiovascular health over time.

This work has important applications for clinicians because the capacity to attain, maintain, or regain FCR depends in part on life experience. Physician counseling in making lifestyle and behavior changes is a mainstay of clinical practice. This study suggests that it may not be enough to counsel individuals absent some understanding of their life history; the effectiveness of counseling may depend in part on psychosocial resources within the patient, including the capacity for attention and problem solving. These factors may influence a patient’s ability to engage in behavior change or understand the medical advice being given. Thus, taking a medical history that includes information regarding the social environment and the availability of psychosocial resources can provide clinicians with important contextual information to use in tailoring medical advice. Simple paper-and-pencil attention deficit self-report symptom scales for adults are available for use in clinical practice and can be informative in identifying patients who may need additional supports to change behavior. Although cognitive ability assessments may not be practically conducted in a clinical setting, physicians can ask patients about their educational history as a proxy (eg, Did you graduate high school? Did you receive any educational services as a child? Have you been diagnosed with cognitive or developmental disability?). Such information can be useful in identifying the need to tailor a behavior change plan to be understandable, and potentially more efficacious, for the patient.

From a primordial prevention perspective, this study also suggests that many of the assessments pediatricians already perform could be useful in promoting cardiovascular health. Childhood attention capacity can be assessed in a clinical setting with short, validated paper-and-pencil measures. Aspects of the home environment can be assessed via taking medical histories to identify instability or social stressors in the home. These assessments provide information on the child’s psychosocial assets and needs while also affording an opportunity to intervene (eg, developmental testing, connections to social services). Although assessing cognitive ability generally requires standardized testing outside the clinician’s office, pediatricians can refer children at high risk of developing cognitive problems (eg, premature infants) to programs that build such capacities. These efforts may enhance the child’s immediate psychosocial environment as well as support the development of healthy cardiovascular functioning.

Evidence is accumulating that CVD may have developmental origins in childhood and that psychosocial factors may influence risk and resilience trajectories earlier than was previously considered. This study further demonstrates that positive early-life psychosocial factors may promote healthy cardiovascular functioning later in life. As such, increasing the prevalence of FCR in the population may hinge in part on enhancing and protecting early-life psychosocial assets. Doing so may lay the foundation for a lifetime of positive cardiovascular health.

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Disclosures

None.

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**CLINICAL PERSPECTIVE**

The American Heart Association’s national goals for cardiovascular health promotion emphasize that cardiovascular risk originates early in life, but little is known about childhood factors that may increase the likelihood of having favorable cardiovascular risk (eg, healthy blood pressure and lipid levels, no smoking, no diabetes mellitus, low body mass index, no antihypertensive or cholesterol medication use) in adulthood. We examined the prospective association of positive childhood factors assessed at age 7 years (attention regulation, cognitive ability, and home environment) and the likelihood of developing favorable cardiovascular risk in midlife. We demonstrate that positive childhood factors promote cardiovascular health in midlife, and the health benefit of having multiple childhood psychosocial assets is additive. We also demonstrate that positive childhood factors set up healthy lifestyle trajectories that cumulatively promote cardiovascular health over time. This study suggests that the capacity to attain, maintain, or regain a favorable cardiovascular health depends in part on life experience. Physician counseling in making lifestyle changes to reduce or prevent cardiovascular disease is a mainstay in clinical practice. This study suggests that the effectiveness of counseling may depend in part on psychosocial resources within the patient, including the capacity for attention and problem solving. These factors can be readily assessed in clinical practice and may influence a patient’s ability to engage in behavior change or understand the medical advice being given. From a primordial prevention perspective, this study suggests that pediatricians should evaluate the patient’s social, emotional, and physical environment and refer to services that build psychosocial resources. Doing so may support cardiovascular health for a lifetime.
A Prospective Study of Positive Early-Life Psychosocial Factors and Favorable Cardiovascular Risk in Adulthood
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