Impact of childhood parent-child relationships on cardiovascular risks in adolescence

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ABSTRACT

This study aims to determine prospective effects of the childhood parent-child relationships on the development of cardiovascular risks in adolescence. Using available 917 parent-child dyads from the Study of Early Child Care and Youth Development (1991 to 2006), we analyzed the prospective effects of childhood parent-child relationships of Conflict and Closeness, as well as their categorized combinations (Harmonic, Dramatic, Hostile, and Indifferent) on the development of subscapular and triceps skinfold thickness (SST/TST), body mass index (BMI), systolic and diastolic blood pressure (SBP/DBP), and heart rate (HR) during adolescence. We found that higher levels of Conflict in the relationship with mothers (slope = 0.05, $P < 0.001$) and fathers (slope = 0.04, $P = 0.03$) increased the growth rate of TST among girls during adolescence, but not among boys. The maternal-girl dyadic with higher Conflict scores also increased girl's growth rate of BMI percentile (slope = 0.10, $P = 0.02$), though the paternal-boy dyadic with higher Conflict scores decreased boy's growth rate of BMI percentile (slope = -0.13, $P = 0.04$). A Hostile maternal-son relationship lowered boy's growth rate of SBP (slope = -3.15, $P < 0.001$) and DBP (slope = -4.42, $P < 0.001$). A Dramatic maternal-son relationship increased boy's growth rate of SST (slope = 0.89, $P < 0.001$) and TST (slope = 0.64, $P = 0.03$). Hostile paternal-daughter relationships were positively associated with the growth rate of TST (slope = 0.28, $P = 0.03$). Overall, there was a significant influence of childhood parent-child relationships on the development of cardiovascular risks during adolescence, and the effect was further modified by both parents' and child's gender.

1. Introduction

Cardiovascular disease (CVD) is the leading cause of death in the United States, accounting for approximately 610,000 deaths in 2013 (Murphy et al., 2016). Although obesity and hypertension in adulthood are well-established precursors to CVD (Gordon et al., 1977; Gordon and Kannel, 1982), undesirable development trajectories have been identified as independent risk factors when occurring in childhood and adolescence (Antonisamy et al., 2017; Hubert et al., 1983; Marx, 2002). Health and risk of cardiovascular disease development has been measured by a set of indicators including body mass index, skinfold thickness, blood pressure, and heart rate across the lifespan. A number of psychosocial stressors influence the development of cardiovascular

health measures (CVHMs) in youth. Certain investigations have identified links between family relationships and the CVHMs in the early life course. Both maternal and paternal closeness and warmth in early life have been consistently identified as protective to the CVHMs (*e.g.* blood pressure, heart rate, and body mass index) during both childhood and adulthood (Bell and Belsky, 2008; Carroll et al., 2013; Pendry and Adam, 2007). In contrast, negative parent-child relationships have been linked to the undesirable development of the risk factors and more CVD events in adulthood. For example, increased childhood weight has been associated with higher levels of parental control, lower levels of parental support, and worse communication between children and their parents (Skouteris et al., 2012).

Although existing literature has found connections between the

parent-child relationships and the CVHMs, there are still areas which require investigation to augment the current understanding. First, the one-time measurement of the outcomes (*e.g.* the CVHMs) in previous studies is limited in fully understanding the development of the cardiovascular health status. This is especially the case for adolescents whose CVHMs are in the critical developmental period (Theodore et al., 2015; Xie et al., 2011). Thus, researchers should pay more attention to the longitudinal development of CVHMs with multiple measurements across adolescence. Secondly, the relationship between parent and child is not necessarily stable throughout childhood and adolescence (Rossi and Rossi, 1990). The cumulative effect of the parent-child relationship during this entire period warrants investigation with prospective cohort studies. Finally, the impact of the dyadic parent-child relationship, either a pair of the mother or the father and either the son or the daughter, may vary substantially based on the gender of both the parent and the child. The majority of existing studies have examined either only the influence of the mother, or assessed both parents together as a whole (Chen and Kennedy, 2004; Chen and Kennedy, 2005; Gorman, 1998). However, research on parental attachment has suggested some qualitative differences between fathers and mothers in terms of their responses to child distress (Nelson et al., 2009). Thus, it may be important to investigate the influences of the father as distinct from the mother in conjunction with the child's gender to better understand factors relevant to adolescent CVHMs development.

Using data from National Institute of Child Health and Human Development Study of Early Child Care and Youth Development (SECCYD), this study aims to improve current understanding about the longitudinal effect of parent-child relationships on the development of certain CVHMs by addressing the following questions: 1) How does the cumulative parent-child relationship during childhood prospectively impact the development of CVHMs during adolescence? 2) What are the varying influences of the father separating from the mother in conjunction with the child's gender relative to the adolescent's development of CVHMs?

2. Methods

2.1. Study sample

This study used data from the SECCYD, a longitudinal cohort study of 1364 children in 10 US locations (Bradley et al., 2008). Participants were followed from infancy (1 month) in 1991 through adolescence (age 15), obtaining physical measurements of the children and psychosocial evaluations from the parents at regular intervals. A detailed description of the data collection procedures and instruments can be found in the complete study manual (NICHD, 1991–2007). In the current study 917 children who had all six measurements performed at least once between the agers of 12 and 15 were included. The measurements were: subscapular skinfold thickness (SST), triceps skinfold thickness (TST), body mass index (BMI), systolic/diastolic blood pressure (SBP/DBP), and heart rate (HR). The current study has been approved by the Institutional Review Board at Claremont Graduate University.

2.2. Measures

2.2.1. Body mass index

Height and weight were assessed using standardized procedures (NICHD, 1991–2007), and measurements were used to calculate the participants' age- and sex-specific BMI percentile according to the guidelines from Centers for Disease Control and Prevention.

2.2.2. Blood pressure and heart rate

Each participant was required to rest for 2 min in the examination chair prior to the SBP, DBP, and HR readings in order to ensure a resting value was obtained. Five seated readings were taken automatically at one minute intervals with the right arm using a DINAMAP Pro 100 model from GE Healthcare. The last three readings were averaged as the final measurement value.

2.2.3. General adiposity

Participants' TST and SST were measured to assess children's general adiposity. Readings were taken on the right side of children's body with Lange Skinfold Calipers, manufactured by Cambridge (Maryland) Scientific Industries, Inc. Measures were repeated three times at each site. The value was recorded if two of the three measurements were identical; otherwise, the average of the three was used.

2.3. Parent-child relationship scale

A 15-item questionnaire with 5-point Likert-style responses was administered to both parents individually to assess the parent-child relationship at the child's age of 4.5, 6, 8, 9, 10, and 11 years respectively. The assessment asked about the parent's feelings and beliefs about his/her relationship with the child, as well as about the child's behavior toward the parent. This scale consisted of two scored components: 1) Conflict with Child was computed as the sum of items 2, 8, 10, 11, 12, 13, and 14, and; 2) Closeness with Child was computed as the sum of items 1, 3, 4 (reflected), 5, 6, 7, 9, and 15. Higher scores indicating greater conflict/closeness between the parent and his/her child. Cronbach's alpha ranged from 0.79 to 0.87 for the measures of both Conflict and Closeness in both parents-child relationships across child's age 4.5 to 11 years.

2.4. Parent-child relationship categorization

Using the Closeness and Conflict scores for parent-child relationships, four discrete categories were created in order to better understand these dynamics and their effects. First, cumulative Closeness and Conflict scores were calculated as the arithmetic mean of all available Closeness and Conflict scores obtained across childhood (*i.e.* measured for six times at child's age 4.5, 6, 8, 9, 10, and 11 years). Next, the distribution of the cumulative scores was examined. Given the normal distribution of the cumulative Conflict and Closeness scores, their means were used as the cut-off values, where scores above the means were defined as *high* and scores equal to or below the means were *low*. Eventually, four distinct groups were created (Fig. 1): 1) Dramatic: high closeness and high conflict, 2) Harmonic: high closeness and low conflict, 3) Hostile: low closeness and high conflict, and 4) Indifferent: low closeness and low conflict.

2.5. Statistical analyses

Means, standard deviation, and proportion were used to describe the CVHMs, parent-child relationships, and pertinent confounders. These statistics were further stratified by child's gender, and compared with *t*-test or Chi-squared tests. Random-effect models were used to evaluate the longitudinal impact of the childhood cumulative Conflict and Closeness scores on children's development of CVHMs from ages 12–15 years. In addition, using Harmonic relationships as a reference group, the three other categories (Dramatic, Hostile, and Indifferent) were examined in the random-effect model for more precise understanding of the impact of Conflict and Closeness in the development of CVHMs. With random-effect modeling, the development of CVHMs can be quantified as a growth curve which was estimated by two coefficients: the intercept (*i.e.*, the initial status at age 12) and slope coefficient (*i.e.*, the growth rate from age 12 to 15). Maximum likelihood estimation was employed to utilize all available data with missing cases for estimating the parameters and standard errors in the models (Little and Rubin, 2002; Schafer, 1997). Covariates adjusted in the analyses included maternal education level at birth, maternal ethnicity of Hispanic or not, maternal marital status at the child's age of 11 years, and