Adolescent Relational Roots of Adult Blood Pressure: A Fourteen-Year Prospective Study

Joseph P. Allen, Ph.D.,
University of Virginia

Emily L. Loeb, Ph.D.,
University of Virginia

Joseph Tan, Ph.D.,
University of Virginia

Alida A. Davis,
University of Virginia

Bert Uchino
University of Utah

Abstract

Intensity in adolescent romantic relationships was examined as a long-term predictor of higher adult blood pressure in a community sample followed from age 17 to 31. Romantic intensity in adolescence--measured via quantity of time spent alone with a partner and duration of the relationship--was predicted by parents' psychologically controlling behavior, and was in turn found to predict higher resting adult systolic and diastolic blood pressure even after accounting for relevant covariates. The prediction to adult blood pressure was partially mediated via conflict in non-romantic adult friendships and intensity in adult romantic relationships. Even after accounting for these mediators, however, a direct path from adolescent romantic intensity to higher adult blood pressure remained. Neither family income in adolescence nor trait measures of personality assessed in adulthood accounted for these findings. Results are interpreted both as providing further support for the view that adolescent social relationship qualities have substantial long-term implications for adult health, as well as suggesting a potential physiological mechanism by which adolescent relationships may be linked to adult health outcomes.

High blood pressure has been estimated to affect 45% of the U.S. adult population and has been identified as one of the most important preventable factors linked to illness and mortality (James et al., 2014; Muntner et al., 2018). This multi-method study examined the overarching hypothesis that a pattern of enmeshment and intensity in key adolescent social relationships will forecast the presence of future problematic romantic and non-romantic relationships, ultimately culminating in higher blood pressure later in adulthood. This hypothesis addresses potential adolescent relational roots of the robust links identified in adulthood between problematic social relationships, poor physical health and, ultimately,

---

All correspondence should be directed to the first author at allen@virginia.edu, or P.O. Box 400400, Charlottesville, Virginia, 22904.

heightened risk of early mortality (Holt-Lunstad, Smith, & Layton, 2010; Uchino, 2009). Although these links are increasingly recognized within adulthood, the pathways by which they play out are still far from clear (Uchino, 2009). Preventive intervention efforts have also been constrained by the degree to which problematic social relationship patterns have already become entrenched by adulthood, rendering efforts to alter these patterns difficult at best (Davila et al., 2017). Ideally, such efforts should begin well before adult relationship patterns have become ingrained. This, however, requires a developmentally-informed understanding of the *precursors* of relationship difficulties in adulthood that are linked to problematic health outcomes.

So how do adolescent romantic relationships fit into this picture? Developmental task theory suggests that romantic involvement is most likely to be problematic when the intensity of this involvement is out of sync with the capacities of the adolescent at a given developmental stage (McCormick, Kuo, & Masten, 2011; Roisman, Masten, Coatsworth, & Tellegen, 2004). Early in adolescence, precocious involvement in romantic relationships is linked to long-term social difficulties ranging from depressive symptoms to delinquent behavior (Allen, Schad, Oudekerk, & Chango, 2014; Loeb, Kansky, Narr, Fowler, & Allen, 2020). In mid-adolescence, presence of a significant romantic relationship (i.e., lasting 3 months or longer) has been linked to relatively higher levels of depressive symptoms (Davila, 2008; Szwedo, Chango, & Allen, 2015). Later on, across adolescence and early adulthood, high cumulative levels of involvement in romantic relationships have been linked to greater levels of deviant behavior (Cui, Ueno, Fincham, Donnellan, & Wickrama, 2012).

Intense romantic relationships may be particularly problematic for adolescents, as their relative immaturity and inexperience may make it harder for them to cope with the psychological demands of such relationships (Davila, Steinberg, Kachadourian, Cobb, & Fincham, 2004; Szwedo et al., 2015). Moreover, relationships that are intense by virtue of being highly time-consuming –in terms of absorbing time each day and over a period of weeks and months – are likely to crowd out other relationships (Joyner & Udry, 2000; Roth & Parker, 2001) and thus increase the adolescent's sense of the stakes involved in maintaining the relationship. The result is a formative experience of relationships as emotionally overwhelming, potentially autonomy-threatening, and even, ironically, isolating —an experience likely to influence expectations and behaviors in future relationships going forward.

By taking time away from the development of relationships with non-romantic peers intense romantic relationshipls also deprive adolescents of key social learning opportunities. Adolescents who become so wrapped up in a romantic relationship that they stop spending time with other friends are likely to see those other relationships either whither or become more conflictual as their friends come to feel written off. In turn, being cut off from opportunities for the normal development of close peer relationships—at a time when such relationships have been identified as critical to longer-term development—is likely to make these peer relationships more challenging going forward (Allen, Narr, Kansky, & Szwedo, 2020; Szwedo et al., 2015). Notably, a lack of positive *non-romantic* relationships in adulthood has also been reliably linked to higher blood pressure (Grant, Hamer, & Steptoe, 2009; Shankar, McMunn, Banks, & Steptoe, 2011).

Problematic romantic relationships in adolescence have been found to predict similar problems in romantic relationships in young adulthood, suggesting long-term continuities (Madsen & Collins, 2011). At the extreme, long-lasting adolescent relationships with a high frequency of contact between partners have even been found to predict an increased incidence of romantic relationship violence (Giordano, Soto, Manning, & Longmore, 2010). These links are important because ultimately, negativity in *adult* close relationships has been directly linked both to higher blood pressure and to related problematic physiological indicators such as cardiovascular reactivity and artery calcification (Holt-Lunstad, Uchino, Smith, Olson-Cerny, & Nealey-Moore, 2003; Robles & Kiecolt-Glaser, 2003; Uchino et al., 2013; Uchino, Smith, & Berg, 2014).

Consideration of the potential effects of intense romantic relationships naturally leads to the corollary question of *why* adolescents would be initially drawn to them. The most plausible explanation suggests that an inclination toward intensity would be most likely for adolescents who had grown accustomed to intense and autonomy-impinging relationships in their family of origin (Oudekerk, Allen, Hessel, & Molloy, 2015). Psychologically controlling parenting behavior, in which adolescent autonomy is undermined and efforts to achieve independence from parents are discouraged, fits this profile. Such behavior has also been repeatedly identified as having long-term ramifications for social interaction patterns (Loeb, Kansky, Tan, Costello, & Allen, in press) and has even been implicated in problematic long-term physiological patterns of stress response (Loeb, Davis, et al., 2020). Whether the experience of emotionally intense and conflicted relationships within the family actually carries over to predict involvement in intense romantic relationships has not, however been previously examined.

A mediational 'chains of risk' perspective suggests that early stressors, such as those that arise from maladaptive levels of parental or romantic involvement, may predict future health outcomes by cascading forward to influence future relationship struggles, which then mediate links to health outcomes (Ben-Shlomo & Kuh, 2002; Oudekerk et al., 2015). Although such mediated chains of risk—e.g. from adolescent intensity to later relationship problems to higher blood pressure—appear as the most plausible means by which adolescent romantic intensity may be linked to adult blood pressure, a second possibility is that more direct, unmediated links also exist. In adolescence, the stress response system is particularly plastic (Romeo, 2010), and given growing brain functional connectivity, adolescence has been posited as a 'switch point' for the long-term calibration of stress responsivity both in metabolic and anatomic terms (Ben-Shlomo & Kuh, 2002; Gee et al., 2013; Goff et al., 2013; McEwen, 2007). Indeed, adolescence has been suggested to be a second sensitive period for the development of the social brain (Blakemore & Mills, 2014). In adulthood, an altered stress response is considered a key part of the hypertensive process (Balint et al., 2016).

This suggests the possibility that the stress of overly intense romantic experiences in adolescence (and perhaps of the breakups that typically eventually follow (Sbarra & Ferrer, 2006)) may have a formative effect on long-term stress response patterns, and ultimately on adult blood pressure. For example, a devastating breakup in adolescence may leave the individual chronically tense and feeling vulnerable in future relationships. This notion is

consistent with a weathering perspective, which posits that stress at a vulnerable stage of development can have long-term physical health implications regardless of whether or not the stress continues (Geronimus, 2013). In line with this perspective, several recent studies have now linked problematic parental, friend, and romantic relationships in adolescence to longer-term health difficulties in ways that appeared relatively unmediated by future relationship qualities (Allen, Loeb, Tan, & Narr, 2017; Loeb, Davis, et al., 2020). To the best of our knowledge, however, neither chains of risk nor weathering pathways from adolescent relationship qualities to adult blood pressure have been previously examined.

This fifteen-year, multi-method, prospective study examined intense involvement in romantic relationships in a community sample of mid to late adolescents as a predictor of a cascading pattern of relationship difficulties culminating in higher adult resting blood pressure. A developmental model was assessed in which overinvolvement was viewed as predicting adult blood pressure both directly and as mediated via future difficulties establishing successful social relationships.

This study tested four primary hypotheses:

1. Intense adolescent romantic involvement will predict higher adult resting blood pressure.

2. Intense involvement will be predicted by psychologically controlling parenting and will in turn predict a cascade of future romantic and peer relationship qualities reflecting negativity and conflict in later relationships.

3. The primary long-term effects of early intense involvement will be mediated via these future relationship qualities; the possibility of direct (i.e., weathering) predictions, independent of future relationship qualities, will also be examined.

4. Predictions will exist over and above baseline family income and trait markers of adult personality characteristics.

Methods

Participants

This report is drawn from a larger longitudinal investigation of adolescent peer and romantic partner influences on adult development. The final sample of 146 participants was a subsample of an original sample of 184 participants assessed as part of a broader study at age 13, who had both data on romantic relationships at ages 17 to 19 and on blood pressure at ages 29 and/or 31 (an attrition rate of approximately 1% per year across 18 years). The final sample included 62 males and 84 females and was racially/ethnically and socioeconomically diverse and representative of the community from which it was drawn: 85 adolescents (58%) identified themselves as Caucasian, 44 (30%) as African American, 1 (1%) as Hispanic, 2 (2%) as Asian, 11 (8%) as of mixed race/ethnicity, and 3 (2%) as from other or unreported groups. Adolescents' parents reported a median family income in the $40,000 - $59,999 range at the initial assessment. Adolescents were recruited from the 7th and 8th grades of a public middle school drawing from suburban and urban populations in the Southeastern United States. Information about the study was provided via an initial

mailing to parents with follow-up presentations to students at school lunches. Formal recruitment took place via telephone contact with parents. Students who had already served as close peer informants in the study were not eligible to serve as primary participants. Of students eligible for participation, 63% of adolescents and parents agreed to participation when parents were contacted. Adolescents provided informed assent before each interview session, and parents and adult participants provided informed consent. Interviews took place in private offices within a university academic building.

Assessments in this study were obtained from adolescents, their mothers, and their close friends, as described below, at mean ages 13.3 ($SD = .64$), 14.3 ($SD = .76$), 15.2, ($SD = .81$), 16.4 ($SD = .87$), 17.3 ($SD = .88$), 18.2 ($SD = 1.28$), 19.7 ($SD = 1.07$), 25.7 ($SD = .99$), 26.6 ($SD = 1.00$), 27.6 ($SD = 1.00$), 28.8 ($SD = 1.21$), 30.2 (SD = .96) and 30.8 ($SD = 1.01$). At the age 26 assessment romantic partners of participants who were in a relationship of three months duration or greater also provided data on their satisfaction with that relationship.

Attrition Analyses

Attrition analyses compared the subsample of participants who had data available for adolescent-era romantic intensity *and* adult blood pressure (N = 146) to those who *only* had data for adolescent-era romantic intensity ($N = 36$). Females were more likely than males to have both types of data available (86% continuation rate for females vs. 74% for males, $p = .04$). Attrition analyses also compared the subsample of participants in the final study who did vs. did not have romantic partner data. No differences were found.

These results suggest that attrition was not likely to have distorted any of the findings reported. Nonetheless, to best address any potential biases due to attrition in longitudinal analyses or missing data within waves, full imputation maximum likelihood (FIML) methods were used with analyses including all variables that were linked to future missing data (i.e., where data were not missing completely at random). Because these procedures have been found to yield the least biased estimates when all available data are used for longitudinal analyses (vs. listwise deletion of missing data) (Arbuckle, 1996), the entire original sample was utilized for these analyses. This full sample thus provides the best possible estimates of variances and covariances in measures of interest and was least likely to be biased by missing data.

Procedure

In the initial introduction and throughout all sessions, confidentiality was assured to all study participants and adolescents/adults were told that no one would be informed of any of the answers they provided. Participants' data were protected by a Confidentiality Certificate issued by the U.S. Department of Health and Human Services, which protected information from subpoena by federal, state, and local courts. Transportation and childcare were provided if necessary. Adolescent/adult participants and participants' romantic partners were all paid for participation.

Measures

Primary Measures

Resting Blood Pressure (Ages 29, 31).: A Dinamap Pro100 monitor (Critikon Corporation, Tampa, Florida) was used to measure Systolic and Diastolic Blood Pressure (SBP and DBP). The Dinamap uses the occillometric method to calculate blood pressure. Cardiovascular assessments were obtained via a properly sized occluding cuff positioned on the upper nondominant arm of participants. Mean SBP, DBP were calculated by averaging across three measurements taken during a baseline assessment during which they were asked to relax, sit quietly and watch a soothing ten-minute video. Measurements were taken 7, 8.5, and 10 minutes into the video. Participants were assessed at age 29 and, for a subset, again at age 31 with assessments averaged across the two time points.

Romantic Relationship Intensity (Ages 17–19, 28–30).: The intensity of an adolescent's romantic experience was assessed in terms of the amount of time spent *alone* with the current romantic partner and the duration over which this relationship extended. Participants were asked how much time they currently spend alone with their current romantic partner and given the choice to answer either as a daily average or weekly average (answers given in weekly terms were subsequently translated into average daily hours). Across ages 17 to 19, means ranged from 2.2 to 2.6 hours spent alone with partner per day; across ages 28–30, means ranged from 3.7 to 4.8 hours spent alone with partner per day. These hourly averages were then multiplied by the duration of the current relationship in months, with means in a given year ranging from 12.3 to 15.8 months for the adolescents and 50.1 to 62.7 months for the adults. This product used as the romantic relationship intensity score (effectively, month-hours of time spent alone with a romantic partner). Assessments were repeated each year from ages 17 to 19 and 28 to 30 and then averaged to yield the final score used in analyses. Participants who were not in a relationship at a given assessment point received an intensity score of zero for that point.

Maternal Psychological Control (Age 16).: Participants' mothers completed the 10-item Psychological Control vs. Psychological Autonomy subscale of the Childhood Report of Parenting Behavior (Schaefer, 1965), a widely used measure of psychological control (Barber, 1996). Example items include: "I say if my child really cared for me, she would not do things that cause me to worry"; "I am less friendly with my son/daughter if s/he does not see things my way"; "I am always telling my son/daughter how s/he should behave." Internal consistency was excellent (Cronbach's α = .79).

Peer Conflict (Adulthood (Ages 25–29).: Participants reported their level of conflict with their closest non-romantic friend at the time of the assessment using three scales from the Network of Relationships Inventory (Furman & Burhmester, 1985), each comprised of three items. These included scales for conflict, antagonism, and punishing behaviors in the relationship. Scores for these items were summed and averaged to yield a total conflict score for each year. The assessment was repeated annually from ages 25 to 29 and scores across years were averaged to yield the final peer conflict measure. The measure displayed strong reliability within year (Cronbach's α's ranged from .90 to .94 across year), and a fair degree of consistency from one year to the next (r's range from .51 to .62, p's < .001).

***Romantic Partner Satisfaction* (Age 26).:** Romantic partners of participants were surveyed at participant age 27 regarding their satisfaction with the relationship with the participant using the three-item satisfaction scale of the Network of Relationships Inventory (Furman & Burhmester, 1985). Internal consistency for the scale was good (Cronbach's α = .90).

History of Serious Illness Prior to Age 18.: During the adult phase of the study, participants reported on presence vs. absence of 43 distinct significant health problems which were first experienced prior to age 18 and which lead at some point to a hospitalization. This measure provided a baseline marker of potential pre-existing health difficulties and has been previously found to predict current adult health quality (Allen, Uchino, & Hafen, 2015).

Big Five Personality Traits (Ages 24).: At age 24, the Big Five personality traits were assessed with the 50-item International Personality Item Pool (Goldberg et al., 2006), using a 5-point Likert-scale, summing across 10 items each tapping constructs of *extraversion, agreeableness, conscientiousness, emotional stability, and imagination*. This measure has previously demonstrated strong internal consistency, retest reliability, convergence with longer Big Five personality measures, and self-peer agreement (Goldberg et al., 2006). For this sample internal consistency for the scales ranged from Cronbach's α = .74 to .89.

Covariates and Measures Used in Post-hoc Analyses

***Body Mass Index (BMI,* Ages 29, 31).:** BMI was assessed at the age 29 and age 31 assessments. Height (in meters) and weight (in kilograms) were assessed with light clothing and BMI was calculated using the standard formula BMI = weight / height^2, which was then averaged across the two assessment points and log-transformed.

Household Income was assessed in terms of the total family income as reported by parents in the adolescent's household at participant age 13, 16, and 18, on a scale ranging from 1 – under $5,000 annually to 8 – more than $60,000 annually in 1998–2003 dollars. Scores were averaged across these three assessments.

***Close Friendship Quality* (Ages 17–19).:** Each year from age 17 to 19, close friends rated participants on their competence at establishing and maintaining a strong close friendship, using the 4-item friendship competence scale from the Adolescent Self-Perception Profile (Harter, 1988). Although the scale was originally labelled 'close friendship competence,' examination of the items suggests that it is better conceptualized as a measure of the quality and intimacy of the friendship. Items focused, for example, on extent to which teen had "a close friend they share secrets with," "a friend close enough to share really personal thoughts with," and a "really close friend to share things with." Results were averaged across the three years to produce the final scale. Internal consistency was good (Cronbach's α's ranged from .65 to .74 within years).

***State of Mind Regarding Attachment* (Age 24).:** The Adult Attachment Interview (George, Kaplan, & Main, 1996; Kobak, Cole, Ferenz-Gillies, Fleming, & Gamble, 1993) was used to probe individuals' descriptions of their childhood relationships with parents in both abstract terms, and with requests for specific supporting memories. For example, subjects were asked

to list five words describing their early childhood relationships with each parent, and then to describe specific episodes that reflected those words. Other questions focused upon specific instances of upset, separation, loss, trauma, and rejection. Finally, the interviewer asked participants to provide more integrative descriptions of changes in relationships with parents and the current state of those relationships. The interview consisted of 18 questions and lasted one hour on average. Interviews were audiotaped and transcribed for coding.

The AAI Q-set (Kobak et al., 1993) was designed to closely parallel the Adult Attachment Interview Classification System (Main, Goldwyn, & Hesse, 2002), but to yield continuous measures of qualities of attachment organization. Each rater read a transcript and provided a Q-sort description by assigning 100 items into nine categories ranging from most to least characteristic of the interview, using a forced distribution. All interviews were blindly rated by at least two raters with extensive training in both the Q-sort and with formal workshop training and certification for coding using the Adult Attachment Interview Classification System. Q-sorts were then compared with a dimensional prototype sort for *secure vs. anxious interview strategies*, reflecting the overall degree of coherence of discourse, the integration of episodic and semantic attachment memories, and a clear objective valuing of attachment. The individual correlation of the 100 items of an individual's Q-sort with a prototype sort for a maximally secure transcript was then used as that participant's scale security score (ranging from –1.00 to 1.00). Inter-rater reliability, assessed via the intraclass correlation coefficient, for the final security scale score was .71, which is considered in the good range for this statistic (Cicchetti & Sparrow, 1981).

***Popularity* (Ages 13–16).:** Adolescents' capacity to establish themselves as preferred social companions with a range of their peers was assessed using a limited nomination procedure. Each adolescent, their closest friend, and two other target peers were asked to nominate up to 10 peers in their grade with whom they would "most like to spend time on a Saturday night." The raw number of 'like' nominations each teen received was standardized within grade level as a measure of desirability as a social companion in the broader peer group following the procedure described in Coie et al (1982). This approach to assessing social acceptance has been previously found to be relatively stable over time and related to adolescent attachment security, qualities of positive parental and peer interactions, and short-term changes in levels of deviant behavior (Allen, Porter, McFarland, Marsh, & McElhaney, 2005; Allen, Porter, McFarland, McElhaney, & Marsh, 2007; McElhaney, Antonishak, & Allen, 2008). Ratings were averaged across the 4 years to produce the final rating.

Social Skills (Ages 13–17).: The test-based Adolescent Problem Inventory (API) (Freedman, Rosenthal, Donahoe, Schlundt, & McFall, 1978; Gaffney & McFall, 1981) was used to assess adolescents' social problem-solving skill. Adolescents were asked to describe their most likely response to a series of five problematic hypothetical situations. These responses were then rated by coders who were unaware of the hypotheses of the study using a 0 to 10 scale, rating competence in resolving the situation at hand in a way that also makes future problematic situations less likely. Situations included conflicts with peers, romantic partners, and teachers, and situations in which adolescents might be tempted to engage in delinquent behaviors. For example, one situation asked how the participant might deal with

a situation in which a gym teacher unfairly calls the student out and tells him/her to do extra push-ups in front of the class. Another asked how the participant might deal with being harshly confronted by a parent about clothing choices just before heading out to a party. This measure was obtained repeatedly at each of the first 5 waves of data collection using different prompt situations at each wave. Interrater reliabilities calculated using the intraclass correlation coefficient, ranged from $r = .86 - .96$, all of which are considered in the "excellent" range for this statistic (Cicchetti & Sparrow, 1981). The mean of scores across these five waves was used in analyses and this mean demonstrated good internal consistency (Cronbach's $\alpha = .75$).

Anxiety **(Age 18, 20).:** The 20-item trait anxiety scale from the State-trait anxiety inventory (Spielberger, Sydeman, Owen, & Marsh, 1999) was used to measure stable individual differences in anxiety proneness. Responses used a 4-point Likert scale to which participants indicated their agreement to statements such as "I worry too much over something that doesn't really matter." The overall trait anxiety scale has demonstrated strong psychometric properties and external validity (Spielberger et al., 1999), and internal consistency for the scale in this study was high (Cronbach's α's = .89 and .90). Scores were averaged across the two assessment periods.

Attachment Anxiety in Adulthood (Age 23–25).: Attachment anxiety was measured using the Behavioral Systems Questionnaire (Furman & Wehner, 1994), which assess attachment styles with a current partner. The 5-item Preoccupied Attachment subscale includes behaviors such as over dependence and neediness. Higher scores indicate greater endorsement of anxious attachment behaviors. The internal consistency for the adult anxious attachment score is considered good (Cronbach's $\alpha = .71$).

Anxiety in Romantic Relationships (Age 22).: Target participants completed the Multi-Item Measure of Adult Romantic Attachment (Bartholomew & Horowitz, 1991; Brennan, Clark, & Shaver, 1998). From this 36-item measure, anxiety in romantic relationships was assessed. The format for this measure asked participants how they *generally* felt in romantic relationships, not just in the current relationship. Items were scored on a 7-point scale, ranging from "Strongly Disagree" to "Strongly Agree," with lower scores reflecting lower levels of anxiety and avoidance in romantic relationships. Sample items include questions such as, "I get uncomfortable when a romantic partner wants to be very close," and "I do often worry about being abandoned." The scales demonstrated good reliability ($\alpha = .94 - .95$).

Results

Preliminary analyses

Means and standard deviations and intercorrelations for primary variables examined are presented in Table 1. Male gender was strongly related to future blood pressure and was thus included in all analyses. We also examined possible moderating effects of gender on the relation of intensity to future blood pressure. Moderating effects were assessed by creating interaction terms based on the product of the centered main effect variables. No moderating

effects of gender were found for any of the analyses reported below. Three observations for romantic intensity in adolescence and four for intensity in adulthood were more than 3.5 standard deviations above the mean and were trimmed to 3.5 standard deviations from the mean so as not to unduly influence results (results would not have differed appreciably had they been kept untrimmed). Residuals from analyses below all were consistent with a normal distribution (i.e., skewness and kurtosis both $< +/- 1.0$).

Primary analyses

Hypothesis 1: Intense romantic involvement in adolescence will predict higher adult resting blood pressure.—For all primary analyses, SAS PROC CALIS (version 9.4, SAS Institute, Cary, NC) was employed using full information maximum likelihood handling of missing data. For hypothesis 1, separate linear regression models were used to examine predictions of systolic and diastolic blood pressure. Analyses began by entering effects of gender and history of childhood illness. Adult body mass index was entered next. The final step entered adolescent romantic relationship intensity at ages 17–19. Results, presented in Table 2, indicate that after accounting for effects of gender, prior illness and current BMI, romantic relationship intensity was a robust predictor of future blood pressure accounting for increments of approximately 9% and 14% of the variation in adult systolic and diastolic blood pressure, respectively.

Hypothesis 2: Intense romantic involvement in adolescence will be predicted by psychologically controlling maternal behavior and will, in turn, predict a cascade of future romantic and peer relationship qualities reflecting negativity, conflict and intense involvement in later romantic relationships.
—The link from psychologically controlling maternal behavior to adolescent romantic intensity was first examined in a regression model that also controlled for participant gender. This link was highly significant ($\beta = .25$, $p < .001$). Psychological control was not predictive, however, of future romantic or peer relationship qualities beyond adolescence nor of adult blood pressure. Analyses next examined predictions from intense romantic involvement to adult social functioning. Romantic intensity in late adolescence was significantly predictive of higher future conflict and negativity in close friendships at ages 25 to 29 and future romantic relationship intensity at ages 29 to 31, but not of future romantic partner satisfaction at age 26 (results presented in Table 3).

Hypothesis 3: The primary long-term effects of early intense involvement on blood pressure will be mediated via these future romantic and peer qualities; the possibility of direct effects independent of future relationship behaviors will also be examined.—We next considered the extent to which our indicators of relationship difficulties across early adulthood mediated the effects of intense involvement in adolescence. This also allowed us to assess the extent to which predictors from different developmental stages were unique vs. redundant in their prediction of future adult blood pressure. Figure 1 presents effects for prediction of both systolic and diastolic blood pressure. All temporally sensible paths were considered, with all significant paths diagrammed. The final model fit the data well (GFI = .98, AGFI = .91, RMSEA = 0.03, χ^2 (13) =15.3, $p = .29$). The indirect effects of adolescent romantic intensity on blood pressure

were significant for both systolic (Indirect effect = .096 95% C.I.: .036 - .156) and diastolic (Indirect effect = .1032 95% C.I.: .039 - .168) pressure. This final model accounted for 49.1% of the variance in systolic blood pressure and 31.0% of the variance in diastolic blood pressure. This represents increments in prediction for the relationship factors modelled over and above BMI, gender and history of childhood illness of 18.9% and 25.4% of the variance for systolic and diastolic pressure respectively.

Hypothesis 4: Predictions will exist over and above baseline family income and trait markers of personality characteristics.—We examined the Big Five personality measures as a block predicting both systolic and diastolic blood pressure after accounting for gender and BMI using the procedure described above. In neither case did the block approach significance (all p's > .30), nor were any of the measures individually linked to either measure of blood pressure after accounting for effects of gender and BMI. Hence, these measures were not considered further.

We also examined family income as reported by parents repeatedly across the adolescent years and also found that it was not predictive of either measure of blood pressure; hence it was also not considered further.

Post-hoc Analyses

Given the findings above, *post-hoc* analyses addressed several follow-up questions:

Do predictions from early romantic intensity change if adolescents do vs. do not have a strong close friendship in this period? Given the observed links of blood pressure to later close friend relationships, we examined whether predictions from intensity would be altered by the quality of close friendships in adolescence (i.e., exacerbated for those with poor quality friendships; ameliorated for those with good quality friendships). We examined friendship quality aggregated across ages 17–19 as a moderator of predictions from intensity to later blood pressure. For both diastolic and systolic pressure, close friendship quality did serve as a moderator in the expected direction. Simple slopes analysis using the PROCESS macro, version 3.3 (Hayes, 2019) in SAS (Sas Institute, 2015) indicated that for diastolic pressure, effects of intensity remained significant in a range from +1 to −1 *SD* from the mean of friendship quality, with the effect becoming smaller as friendship quality increased. For systolic pressure, intensity remained predictive across low and mean levels of friendship quality but was non-significant as a predictor when friendship quality was at 1 s.d. or more above the mean. This suggests that romantic intensity was more likely to predict higher blood pressure when adolescents were lacking in good quality close friendships. Friendship quality was not directly correlated with either intensity or future blood pressure, however (all p's > .25).

Might results have been driven by inclusion of adolescents who were not in a romantic relationship (i.e., who had scores of 0 on intensity)? To test this possibility, these adolescents were excluded from analyses. When analyses were rerun with the reduced sample, effects of intensity were consistently larger than they were in the full sample indicating that, if anything, including these adolescents was reducing the magnitude of the intensity effects observed.

Might blood pressure predictions have simply reflected the underlying effects of attachment insecurity, attachment anxiety, general anxiety, or low popularity and poor social skills? Analyses considered the degree of security/insecurity in young adults' state of mind at age 24, reported attachment anxiety in romantic relationships at age 23 to 25, reported anxiety at ages 18 to 20 and overall level of popularity and social problem-solving skill earlier in adolescence as predictors of either measure of adult blood pressure. No significant predictions were found to adult blood pressure, nor were these variables linked to adolescent romantic intensity with the exception of popularity which inversely related to adolescent romantic intensity ($r = -.16$, $p = .03$).

Discussion

This prospective study identified a robust link from intense adolescent romantic involvement to higher adult resting blood pressure at ages 29 to 31. Predictions were observed to measures of both diastolic and systolic blood pressure and remained strong even after accounting for participant gender, history of childhood illness, and current body mass index. Intense romantic involvement was found to be predictable from the prior experience of autonomy-undermining maternal behavior. The links from intense romantic involvement to adult blood pressure appeared at least partially mediated via problematic peer and romantic relationships in adulthood. Even after accounting for these mediators, however, adolescent romantic intensity continued to account for substantial variance in adult blood pressure.

Predictions from adolescent romantic intensity were slightly stronger to diastolic than systolic blood pressure, which is important given that it is diastolic pressure in young adults that is most strongly predictive of future cardiovascular disease (Franklin et al., 2001). Notably, although medical intervention is only considered helpful, and therefore indicated, at higher levels of blood pressure, research has consistently found that the link between blood pressure and cardiovascular disease is in fact linear from the low-normal up through high levels of blood pressure (Mason et al., 2004; Psaty et al., 2001). Thus, across all levels, from normal to elevated, *any* degree of increase in blood pressure is equally problematic in terms of its prediction of long-term risks.

The overall magnitude of the predictions obtained is also noteworthy. Even after accounting for BMI and gender, the effect of adolescent romantic intensity accounted for 9% of the variance in systolic pressure and 14% in diastolic pressure. This effect size translates into a 5 to 6 mm Hg difference in diastolic blood pressure between individuals who are one standard deviation above vs. one standard deviation below the mean in adolescent romantic intensity. This effect size--derived from a single measure obtained more than a decade prior—is of the same approximate magnitude as the short-term effects of a number of current medications used to treat hypertension (Wald, Law, Morris, Bestwick, & Wald, 2009).

Romantic intensity in adolescence predicted both future romantic intensity in adulthood as well as difficulties observed in interactions with non-romantic peers. This provides both additional evidence of the maladaptive nature of intense late adolescent relationships, and also suggests that there may be multiple pathways by which this intensity is linked to higher blood pressure. More generally, these findings highlight a fundamental question:

Just what is it about romantic intensity in late adolescence that leads to these problematic associations? It is important to note that relationship *intensity* in adolescence is quite distinct from relationship *quality* (Collins, 2003; Davila et al., 2017). Although relationships can be sources of great support, they can also create great distress, and the evidence within adolescence suggests that more intense relationships are more apt to create such distress (Giordano et al., 2010; Kaestle & Halpern, 2005). Indeed, Giordano et al. (2010) found that the provision and receipt of more instrumental support within teen dating relationships was associated with an increased risk of dating violence— perhaps *too much* of a 'good thing' could signal the presence of an inappropriately-consuming and demanding relationship. It also appears that it was intensity *that is out of keeping with developmental norms* in adolescence that was most problematic: Adolescent relationships are often intense, but it was when intensity was higher than this normative intensity that it was predictive of future blood pressure.

However enticing an intense romantic relationship may be in late adolescence, it is nevertheless going to take away time and effort from close friendships and non-romantic socialization and activities, all of which appear to be particularly important to move development forward at this stage (Allen et al., 2020; Roisman, Aguilar, & Egeland, 2004). Notably, in this study, to the extent this did *not* seem to be occurring (i.e., close friendship quality was rated as high by friends), the effects of intensity were greatly reduced or eliminated. Further, it is likely that the late adolescent will have difficulty managing the intense emotions generated by relationships that soak up large amounts of their time and incorporate relatively little interaction with others outside the relationship. Indeed, this intensity may reflect a premature transfer of attachment functions from the parent to the romantic partner in a way that that partner is unlikely to be able to competently handle over time (Collins, Welsh, & Furman, 2009). The combined and potentially mildly suffocating effect of these factors is likely to give rise to conflict and negativity in the current relationship and to more intense distress if and when that relationship ends. Such conflict and rejection has been posited to lead to perceptions of lack of safety which have been reliably linked to numerous long-term stress responses (Slavich, 2020). Given the formative nature of relationships during this period, the problems generated by relationship intensity are also likely to set a template for expectations of conflict, negativity, and threats to autonomy in future relationships. Together, these factors may account both for links to future relationship outcomes and potentially to a pattern for handling relationship stress that is linked to higher blood pressure.

It is notable that the links of intensity to adult blood pressure were not fully mediated via future relationship intensity or other later relationship quality measures, even though these were all assessed far more proximately to the blood pressure assessment. This finding is striking given the long time period across which predictions were observed, but it is also consistent with emerging that has identified links from adolescent relationship behaviors to long-term health outcomes (e.g., interleukin-6 levels, and reported overall health) that did not appear mediated by later relationship qualities (Allen et al., 2017; Allen et al., 2015). It remains entirely possible, of course, that the effects of intensity were mediated by other relationship factors which were not measured across this period, as discussed further below. These findings are consistent, however, with findings from early childhood

research suggesting that health-related effects of exposure to stress can exist even when such stress does not continue into later life (Pollitt et al., 2007). Both animal and human research suggest that adolescence may be a period during which stress reaction systems are particularly malleable and vulnerable to aversive social experience (Quevedo, Johnson, Loman, Lafavor, & Gunnar, 2012; Romeo, 2010).

Notably, the simple presence of a romantic relationship in adolescence has been found to predict future depressive symptoms, with adolescents who are more preoccupied with such relationships being most likely to experience such symptoms (Davila et al., 2004). Given that even intense adolescent romantic relationships are likely to ultimately end, it may be that the strong distress experienced upon the ending of such a relationship is actually a factor leading to higher adult blood pressure. The previously observed links of hyperarousal following romantic dissolution to changes in patterns of blood pressure reactivity in adulthood add plausibility to this notion (Sbarra, Law, Lee, & Mason, 2009). Stressors in adolescence, such as may be created by overly intense relationships or their eventual dissolution, have the potential not only to alter metabolic systems and anatomic structures, but also more basic social and physiological patterns of stress responsivity (Ben-Shlomo & Kuh, 2002; Goff et al., 2013; McEwen, 2007).

An alternative explanation of the observed findings, however, is that intensity in adolescence was a *marker* of a broader pattern of disturbed relationships, which was the primary driver of later blood pressure. The finding that intensity was predicted by psychologically controlling maternal behavior is consistent with a perspective in which intensity reflects a pattern of overinvolvement in intimate relationships, perhaps learned from parents and then cascading forward into new relationships (Oudekerk et al., 2015). It may be that a tendency toward dependence, possessiveness, and/or lack of boundaries in relationships learned in one's family of origin drives both romantic intensity as well as future difficulties. The finding that intensity was much less predictive for adolescents with strong close friendships is consistent with the notion that intensity may be predictive primarily when it reflects a broader pattern of relationship disturbance. It should be noted, however, that neither the most widely used measures of personality in adulthood nor other markers of social functioning in adolescence were predictive of adult blood pressure; this makes it more difficult to argue that the intensity is simply a marker for a broad personality factors as opposed to more subtle relational processes.

Overall, it is perhaps most plausible that multiple explanations for the intensity predictions apply: Intensity may *mark* a problematic relationship tendency and it may also *establish or further* a pattern of problematic relationship behavior that ultimately influences blood pressure. One piece of evidence weighing in favor of the latter possibility is that intensity predicted precisely the type of relationship factors in adulthood (e.g., evidence of conflict and negativity) that have been linked to adult blood pressure in shorter-term, cross-lagged studies (Holt-Lunstad et al., 2003). Clearly, further research is needed to understand which of a variety of possible weathering and mediated mechanisms best account for the intensity effects observed.

Several limitations of this study also warrant consideration. As should be clear from the discussion above, although results are consistent with findings from research in adulthood and extend these to a far earlier stage of the lifespan, direct causal inferences cannot be supported by these data. Relatedly, this study also did not have measures of blood pressure available from the adolescent era. It is thus possible that blood pressure levels were heightened already in adolescence and that what is being observed in this study may in fact be linked to other prior experiences, to a reverse causal process in which blood pressure somehow influences relationship qualities, or to unmeasured temperamental or genetic predispositions that influence both blood pressure and relationship experiences. Of course, even if intensity were simply a marker of risk and not a causal agent, it would still warrant consideration given that it was assessed at an age when blood pressure is likely to appear in the normal range and thus not warrant attention.

In addition, the assessment of romantic intensity was made via a novel measure. This measure, comprising duration and time spent alone with partner in a relationship, certainly captures *some* aspects of intensity and was quite similar to the way others have conceptualized problematically intense relationships (Giordano et al., 2010). The combination of duration and amount of time spent alone with a partner also seems likely to forecast the degree of distress felt upon relationship dissolution; this was not assessed in this study but would be a promising topic for future research. The measurement of romantic intensity is not well-developed overall, however, and other measures of intensity (e.g., self- and partner-reports of the *experience* within the relationship, delineation of activities together, observational data, etc.) will be needed to fully flesh out this construct.

It should also be noted, that although this study posits a developmental perspective on intensity—suggesting it is more problematic in adolescence than later—even in adulthood long duration relationships which involved very large amounts of time spent alone with a partner were somewhat linked to higher blood pressure. This raises the possibility that there may be a facet of such relationships, such as emotional overload, that is linked to higher blood pressure at any age, though this is also a question for future research to pursue. An additional limitation of this study is that it did not have access to measures of biological markers of stress response patterns that might further elucidate the nature of the links observed.

Overall however, these findings contribute to a developing picture suggesting robust links between relational markers of developmental psychopathology in adolescence and long-term *physical* health outcomes. Unfortunately to date, current national recommendations from the primary government agencies tasked with the prevention of age-related disease fail to consider *any* social relationship factors in adolescence or early adulthood (Centers for Disease Control and Prevention, 2017; Holt-Lunstad, Robles, & Sbarra, 2017). The present findings, together with similar findings from related research suggest an urgent need for this to change going forward.

Acknowledgements:

References

Allen JP, Loeb EL, Tan J, & Narr RK (2017). The body remembers: Adolescent conflict struggles predict adult interleukin-6 Levels. Development and Psychopathology, Online Version. doi:10.1017/S0954579417001754

Allen JP, Narr RK, Kansky J, & Szwedo DE (2020). Adolescent Peer Relationship Qualities as Predictors of Long-Term Romantic Life Satisfaction. Child Development, 91(1), 327–340. [PubMed: 30675714]

Allen JP, Porter MR, McFarland CF, Marsh PA, & McElhaney KB (2005). The two faces of adolescents' success with peers: Adolescent popularity, social adaptation, and deviant behavior. Child Development, 76, 747–760. [PubMed: 15892790]

Allen JP, Porter MR, McFarland FC, McElhaney KB, & Marsh PA (2007). The relation of attachment security to adolescents' paternal and peer relationships, depression, and externalizing behavior. Child Development, 78(4), 1222–1239. doi:10.1111/j.1467-8624.2007.01062.x [PubMed: 17650135]

Allen JP, Schad MM, Oudekerk BA, & Chango J. (2014). What ever happened to the 'cool' kids? Long-term sequelae of early adolescent pseudomature behavior. Child Development, 85(5), 1866–1880. doi:10.1111/cdev.12250 [PubMed: 24919537]

Allen JP, Uchino BN, & Hafen CA (2015). Running with the pack: Teen peer-relationship qualities as predictors of adult physical health. Psychological Science, 26(10), 1574–1583. doi:10.1177/0956797615594118 [PubMed: 26290522]

Arbuckle JL (1996). Full information estimation in the presence of incomplete data. In Schumaker GAMRE (Ed.), Advanced structural modeling: Issues and Techniques (pp. 243–277). Mahwah, NJ: Erlbaum.

Balint EM, Gander M, Pokorny D, Funk A, Waller C, & Buchheim A. (2016). High Prevalence of Insecure Attachment in Patients with Primary Hypertension. Front Psychol, 7, 1087. doi:10.3389/fpsyg.2016.01087 [PubMed: 27536255]

Barber BK (1996). Parental psychological control: Revisiting a neglected construct. Child Development, 67(6), 3296–3319. [PubMed: 9071782]

Bartholomew K, & Horowitz LM (1991). Attachment styles among young adults: A test of a four-category model. Journal of Personality and Social Psychology, 61, 226–244. Retrieved from \\file:c:\wx\papers downloaded\bartholomew & horowitz 1991jpsp.htm [PubMed: 1920064]

Ben-Shlomo Y, & Kuh D. (2002). A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. Int J Epidemiol, 31(2), 285–293. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/11980781 [PubMed: 11980781]

Blakemore S-J, & Mills KL (2014). Is adolescence a sensitive period for sociocultural processing? Annual Review of Psychology, 65, 187–207.

Brennan KA, Clark CL, & Shaver PR (1998). Self-report measurement of adult attachment: An integrative overview. In Simpson JA & Rholes WS (Eds.), Attachment theory and close relationships. (pp. 46–76). New York, NY: Guilford Press.

Centers for Disease Control and Prevention. (2017). Four domains of chronic disease prevention. Retrieved from https://www.cdc.gov/chronicdisease/resources/publications/four-domains.htm

Cicchetti DV, & Sparrow SA (1981). Developing criteria for establishing interrater reliability of specific items: Applications to assessment of adaptive behavior. American Journal of Mental Deficiency, 86(2), 127–137. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/7315877 [PubMed: 7315877]

Coie JD, Dodge KA, & Coppotelli H. (1982). Dimensions and types of social status: A cross age perspective. Developmental Psychology, 18, 121–132.

Collins WA (2003). More than Myth: The Developmental Significance of Romantic Relationships During Adolescence. Journal of Research on Adolescence, 13(1), 1–24.

Collins WA, Welsh DP, & Furman W. (2009). Adolescent Romantic Relationships. Annual Review of Psychology, 60(1), 631–652. doi:doi:10.1146/annurev.psych.60.110707.163459

Cui M, Ueno K, Fincham FD, Donnellan MB, & Wickrama KA (2012). The Association between Romantic Relationships and Delinquency in Adolescence and Young Adulthood. Pers Relatsh, 19(2), 354–366. doi:10.1111/j.1475-6811.2011.01366.x [PubMed: 22984343]

Davila J. (2008). Depressive symptoms and adolescent romance: Theory, research, and implications. Child Development Perspectives, 2(1), 26–31.

Davila J, Mattanah J, Bhatia V, Latack JA, Feinstein BA, Eaton NR, . . . Zhou J. (2017). Romantic competence, healthy relationship functioning, and well-being in emerging adults. Personal Relationships, 24(1), 162–184. doi:10.1111/pere.12175

Davila J, Steinberg SJ, Kachadourian L, Cobb R, & Fincham F. (2004). Romantic involvement and depressive symptoms in early and late adolescence: The role of a preoccupied relational style. Personal Relationships, 11(2), 161–178. Retrieved from http://www.blackwellpublishing.com

Franklin SS, Larson MG, Khan SA, Wong ND, Leip EP, Kannel WB, & Levy D. (2001). Does the relation of blood pressure to coronary heart disease risk change with aging? The Framingham Heart Study. Circulation, 103(9), 1245–1249. [PubMed: 11238268]

Freedman BJ, Rosenthal L, Donahoe CP, Schlundt DG, & McFall RM (1978). A social-behavioral analysis of skill deficits in delinquent and nondelinquent adolescent boys. Journal of Consulting & Clinical Psychology, 46(6), 1448–1462. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/730898 [PubMed: 730898]

Gaffney LR, & McFall RM (1981). A comparison of social skills in delinquent and nondelinquent adolescent girls using a behavioral role-playing inventory. Journal of Consulting & Clinical Psychology, 49(6), 959–967. [PubMed: 7309963]

Gee DG, Humphreys KL, Flannery J, Goff B, Telzer EH, Shapiro M, . . . Tottenham N. (2013). A developmental shift from positive to negative connectivity in human amygdala-prefrontal circuitry. Journal of Neuroscience, 33(10), 4584–4593. doi:10.1523/JNEUROSCI.3446-12.2013 [PubMed: 23467374]

George C, Kaplan N, & Main M. (1996). Adult Attachment Interview. Unpublished manuscript, Department of Psychology, University of California, Berkeley (third edition). In.

Geronimus AT (2013). Deep integration: letting the epigenome out of the bottle without losing sight of the structural origins of population health. American Journal of Public Health, 103(S1), S56–S63. [PubMed: 23927509]

Giordano PC, Soto DA, Manning WD, & Longmore MA (2010). The characteristics of romantic relationships associated with teen dating violence. Social science research, 39(6), 863–874. [PubMed: 21037934]

Goff B, Gee DG, Telzer EH, Humphreys KL, Gabard-Durnam L, Flannery J, & Tottenham N. (2013). Reduced nucleus accumbens reactivity and adolescent depression following early-life stress. Neuroscience, 249, 129–138. doi:10.1016/j.neuroscience.2012.12.010 [PubMed: 23262241]

Goldberg LR, Johnson JA, Eber HW, Hogan R, Ashton MC, Cloninger CR, & Gough HG (2006). The international personality item pool and the future of public-domain personality measures. Journal of Research in Personality, 40(1), 84–96. doi:10.1016/j.jrp.2005.08.007

Grant N, Hamer M, & Steptoe A. (2009). Social isolation and stress-related cardiovascular, lipid, and cortisol responses. Annals of Behavioral Medicine, 37(1), 29–37. [PubMed: 19194770]

Harter S. (1988). Manual for the Self-Perception Profile for adolescents. Denver, Colorado: University of Denver.

Hayes AF (2019). Introduction to Mediation, Moderation, and Conditional Process Analysis, Second Edition : A Regression-Based Approach. ProQuest Ebook Central (http://ebookcentral.proquest.com/lib/uva/detail.action?docID=5109647): Guilford.

Holt-Lunstad J, Robles TF, & Sbarra DA (2017). Advancing social connection as a public health priority in the United States. Am Psychol, 72(6), 517–530. doi:10.1037/amp0000103 [PubMed: 28880099]

Holt-Lunstad J, Smith TB, & Layton JB (2010). Social relationships and mortality risk: A meta-analysis. PLoS Medicine, 7(7), 1–20. doi:10.1371/journal.pmed.1000316

Holt-Lunstad J, Uchino BN, Smith TW, Olson-Cerny C, & Nealey-Moore JB (2003). Social relationships and ambulatory blood pressure: structural and qualitative predictors of cardiovascular function during everyday social interactions. Health psychology : official journal of the

Division of Health Psychology, American Psychological Association, 22(4), 388–397. doi:10.1037/0278-6133.22.4.388 [PubMed: 12940395]

James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, . . . Ortiz E. (2014). 2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). JAMA, 311(5), 507–520. doi:10.1001/jama.2013.284427 [PubMed: 24352797]

Joyner K, & Udry J. (2000). You don't bring me anything but down: Adolescent romance and depression. Journal of Health & Social Behavior, 41(4), 369–391. [PubMed: 11198563]

Kaestle CE, & Halpern CT (2005). Sexual intercourse precedes partner violence in adolescent romantic relationships. Journal of Adolescent Health, 36(5), 386–392.

Kobak RR, Cole H, Ferenz-Gillies R, Fleming W, & Gamble W. (1993). Attachment and emotion regulation during mother-teen problem-solving: A control theory analysis. Child Development, 64(1), 231–245. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/8436031 [PubMed: 8436031]

Loeb EL, Davis AA, Narr RK, Uchino BN, Kent de Grey RG, & Allen JP (2020). The developmental precursors of blunted cardiovascular responses to stress. Developmental psychobiology.

Loeb EL, Kansky J, Narr RK, Fowler C, & Allen JP (2020). Romantic Relationship Churn in Early Adolescence Predicts Hostility, Abuse, and Avoidance in Relationships Into Early Adulthood. Journal of Early Adolescence. doi:10.1/107.171/0772/7027423413611691988999477

Loeb EL, Kansky J, Tan J, Costello M, & Allen JP (in press). Perceived Psychological Control in Early Adolescence Predicts Lower Levels of Adaptation into Mid-Adulthood. Child Development.

Madsen SD, & Collins WA (2011). The Salience of Adolescent Romantic Experiences for Romantic Relationship Qualities in Young Adulthood. Journal of Research on Adolescence, 21(4), 789–801. doi:10.1111/j.1532-7795.2011.00737.x

Main M, Goldwyn R, & Hesse E. (2002). Adult attachment scoring and classification systems, Version 7.1. Unpublished Manuscript, University of California at Berkeley.

Mason PJ, Manson JE, Sesso HD, Albert CM, Chown MJ, Cook NR, . . . Glynn RJ (2004). Blood pressure and risk of secondary cardiovascular events in women: the Women's Antioxidant Cardiovascular Study (WACS). Circulation, 109(13), 1623–1629. [PubMed: 15023883]

McCormick CM, Kuo SI, & Masten AS (2011). Developmental tasks across the life span.

McElhaney KB, Antonishak J, & Allen JP (2008). They like me, they like me not: Popularity and adolescents' perceptions of acceptance predicting changing social functioning over time. . Child Development, 79, 720–731. [PubMed: 18489423]

McEwen BS (2007). Physiology and neurobiology of stress and adaptation: central role of the brain. Physiology Review, 87(3), 873–904. doi:10.1152/physrev.00041.2006

Muntner P, Carey RM, Gidding S, Jones DW, Taler SJ, Wright JT, & Whelton PK (2018). Potential US population impact of the 2017 ACC/AHA high blood pressure guideline. Journal of the American College of Cardiology, 71(2), 109–118. [PubMed: 29146532]

Oudekerk BA, Allen JP, Hessel ET, & Molloy LE (2015). The cascading development of autonomy and relatedness from adolescence to adulthood Child Development, 86(2), 472–485. doi:10.1111/cdev.12313 [PubMed: 25345623]

Pollitt RA, Kaufman JS, Rose KM, Diez-Roux AV, Zeng D, & Heiss G. (2007). Early-life and adult socioeconomic status and inflammatory risk markers in adulthood. European journal of epidemiology, 22(1), 55–66. doi:10.1007/s10654-006-9082-1 [PubMed: 17225957]

Psaty BM, Furberg CD, Kuller LH, Cushman M, Savage PJ, Levine D, . . . Lumley, T. (2001). Association between blood pressure level and the risk of myocardial infarction, stroke, and total mortality: the cardiovascular health study. Archives of Internal Medicine, 161(9), 1183–1192. [PubMed: 11343441]

Quevedo K, Johnson A, Loman M, Lafavor T, & Gunnar M. (2012). The Confluence of Adverse Early Experience and Puberty on the Cortisol Awakening Response. International Journal of Behavioral Development, 36(1), 19–28. doi:10.1177/0165025411406860 [PubMed: 22383860]

Robles TF, & Kiecolt-Glaser JK (2003). The physiology of marriage: Pathways to health. Physiology & behavior, 79(3), 409–416. [PubMed: 12954435]

Roisman GI, Aguilar B, & Egeland B. (2004). Antisocial behavior in the transition to adulthood: The independent and interactive roles of developmental history and emerging developmental tasks. Development and Psychopathology, 16(4), 857–871. 10.1017/S0954579404040040 http://search.epnet.com/login.aspx?direct=true&db=psyh&an=2005-00360-004 [PubMed: 15704818]

Roisman GI, Masten AS, Coatsworth JD, & Tellegen A. (2004). Salient and emerging developmental tasks in the transition to adulthood. Child Development, 75(1), 123–133. Retrieved from http://www.jstor.org/stable/3696570 [PubMed: 15015679]

Romeo RD (2010). Adolescence: a central event in shaping stress reactivity. Developmental psychobiology, 52(3), 244–253. doi:10.1002/dev.20437 [PubMed: 20175102]

Roth MA, & Parker JG (2001). Affective and behavioral responses to friends who neglect their friends for dating partners: Influences of gender, jealousy and perspective. Journal of Adolescence, 24(3), 281–296. [PubMed: 11476607]

Sas Institute. (2015). SAS, Version 9.4. Cary, NC: Author.

Sbarra DA, & Ferrer E. (2006). The structure and process of emotional experience following nonmarital relationship dissolution: Dynamic factor analyses of love, anger, and sadness. Emotion, 6(2), 224. [PubMed: 16768555]

Sbarra DA, Law RW, Lee LA, & Mason AE (2009). Marital dissolution and blood pressure reactivity: evidence for the specificity of emotional intrusion-hyperarousal and task-rated emotional difficulty. Psychosom Med, 71(5), 532–540. doi:10.1097/PSY.0b013e3181a23eee [PubMed: 19414618]

Schaefer ES (1965). Children's reports of parental behavior: An inventory. Child Development, 36(2), 413–424. [PubMed: 14300862]

Shankar A, McMunn A, Banks J, & Steptoe A. (2011). Loneliness, social isolation, and behavioral and biological health indicators in older adults. Health Psychology, 30(4), 377. [PubMed: 21534675]

Slavich GM (2020). Social safety theory: A biologically based evolutionary perspective on life stress, health, and behavior. Annual Review of Clinical Psychology, 16. doi:10.1146/annurev-clinpsy-032816-045159

Spielberger CD, Sydeman SJ, Owen AE, & Marsh BJ (1999). Measuring anxiety and anger with the State-Trait Anxiety Inventory (STAI) and the State-Trait Anger Expression Inventory (STAXI). In Maruish ME (Ed.), The use of psychological testing for treatment planning and outcomes assessment (2nd ed., pp. 993–1021). Mahwak, NJ, US: Lawrence Erlbaum Associates Publishers.

Szwedo DE, Chango JM, & Allen JP (2015). Adolescent Romance and Depressive Symptoms: The Moderating Effects of Positive Coping and Perceived Friendship Competence. Journal of Clinical Child & Adolescent Psychology, 44(4), 538–550. doi:10.1080/15374416.2014.881290 [PubMed: 24645877]

Uchino BN (2009). What a lifespan approach might tell us about why distinct measures of social support have differential links to physical health. Journal of Social and Personal Relationships, 26(1), 53–62. doi:10.1177/0265407509105521 [PubMed: 20221309]

Uchino BN, Bosch JA, Smith TW, Carlisle M, Birmingham W, Bowen KS, . . . O'Hartaigh B. (2013). Relationships and cardiovascular risk: perceived spousal ambivalence in specific relationship contexts and its links to inflammation. Health psychology : official journal of the Division of Health Psychology, American Psychological Association, 32(10), 1067–1075. doi:10.1037/a0033515 [PubMed: 23914811]

Uchino BN, Smith TW, & Berg CA (2014). Spousal relationship quality and cardiovascular risk: dyadic perceptions of relationship ambivalence are associated with coronary-artery calcification. Psychological science : a journal of the American Psychological Society / APS, 25(4), 1037–1042. doi:10.1177/0956797613520015

Wald DS, Law M, Morris JK, Bestwick JP, & Wald NJ (2009). Combination therapy versus monotherapy in reducing blood pressure: meta-analysis on 11,000 participants from 42 trials. The American journal of medicine, 122(3), 290–300. [PubMed: 19272490]
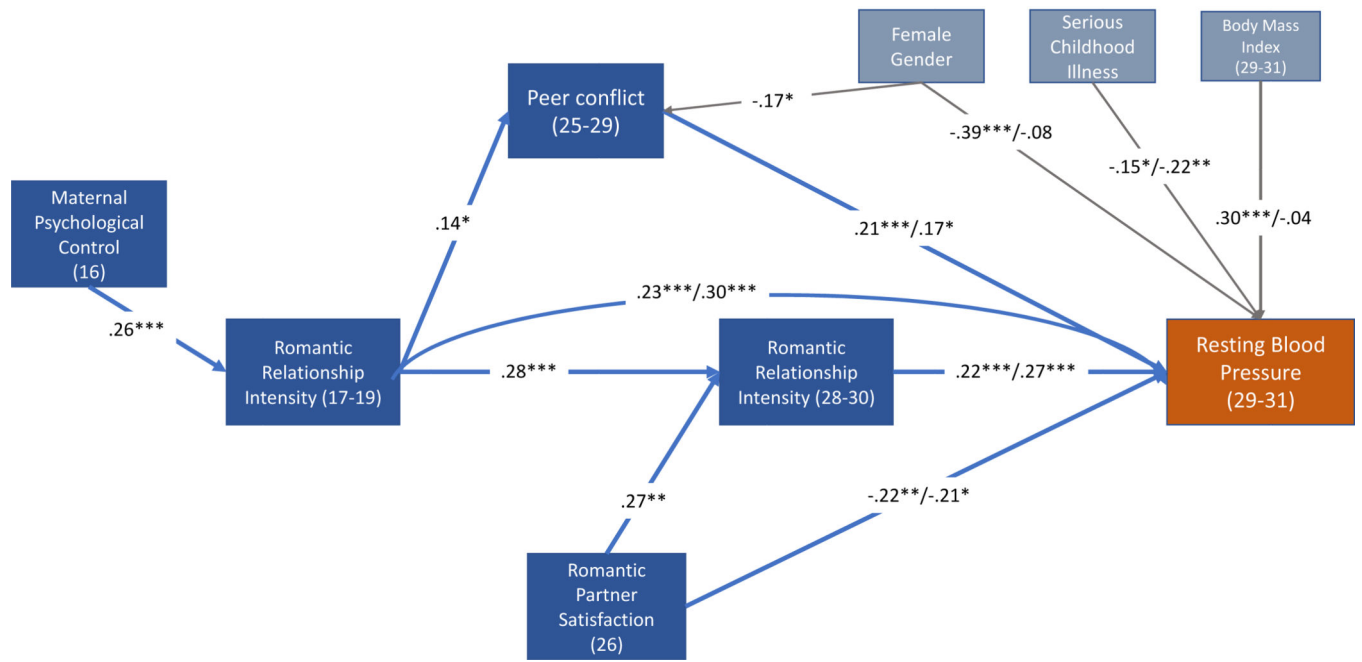
Figure 1.
Relationship Predictors of Adult Blood Pressure
Note: Predictions of blood pressure are presented as systolic/diastolic.

Table 1

Univariate Statistics and Intercorrelations Among Primary Constructs

	Mean	SD	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Systolic BP (Ages 29, 31)	114.2	12.0	.68***	.33***	.23**	.03	.28***	-.16	-.39***	-.21**	-.05	-.18*	.13	.23**	-.10
2. Diastolic BP (Ages 29, 31)	63.1	8.07	--	.38***	.29***	.04	.15	-.18	-.11	-.19*	.07	-.02	-.04	.17	-.05
3. Romantic Intensity (Ages 17–19)	33.4	66.7		--	.28***	.25***	.09	.01	.08	.07	.15	-.08	-.06	-.09	-.07
4. Romantic Intensity (Ages 28–30)	231.9	320.4			--	-.01	-.21**	.32***	.14	.16*	.09	.02	-.03	-.06	-.17*
5. Maternal Psychological Control (Age 16)	13.5	3.54				--	.15	-.14	.04	.01	.09	-.13	-.01	-.01	.01
6. Peer Conflict (Ages 25–29)	4.0	1.34					--	-.01	-.16*	.05	-.09	-.24**	-.15	-.15	-.15
7. Romantic Partner Satisfaction (Age 26)	13.2	2.40						--	.05	-.05	.04	.36***	.16	-.03	.13
8. Adolescent Gender (1 - Male; 2-Female)	--	--							--	.14	-.02	.21**	.11	-.27***	-.15
9. History of Childhood Illness	0.17	0.44								--	.08	.05	.12	-.12	.05
10. Extraversion (Age 24)	34.9	7.40									--	.31***	.27***	.31***	.32***
11. Agreeableness (Age 24)	39.8	5.51										--	.50***	.14	.53***
12. Conscientiousness (Age 24)	37.3	6.08											--	.31***	.37***
13. Emotional Stability (Age 24)	34.2	8.73												--	.10
14. Openness (Age 24)	38.9	5.62													--

Note: Target participant age(s) at time of assessment are in parentheses.

*** p < .001.

** p < .01.

* p < .05.

Table 2

Predicting Adult Resting Systolic Blood Pressure from Intense Romantic Involvement in Late Adolescence

	Systolic Blood Pressure (Age 29–31)				Diastolic Blood Pressure (Age 29–31)			
	β entry	β final	R^2	Total R^2	β entry	β final	R^2	Total R^2
Step I.								
Gender (Male=1; Female =2)	−.36***	−.42***			−.07	−.09		
History of Childhood Illness	−.15*	−.11			−.18	−.20**		
Summary Statistics for Step			.166***	.166***			.042	.042
Step II.								
Adult Body Mass Index	.39***	.36***	.133***	.299***	.06	.01	.004	.046
Step III.								
Adolescent Romantic Relationship Intensity (Ages 17–19)	.30***	.30***	.086***	.385***	.38***	.38***	.136***	.182***

Note.

*** $p < .001$.

** $p < .01$.

* p .05.

Table 3

Predicting Future Relationship Qualities from Adolescent Romantic Relationship Intensity

	Model 1: Peer Conflict (Ages 25–29)			Model 2: Romantic Partner Satisfaction (Age 26)			Model 3: Romantic Relationship Intensity (Ages 29–31)		
	β	R^2	R^2	β	R^2	R^2	β	R^2	R^2
Step I.									
Gender (Male=1; Female =2)	−.18*			.06			.11		
History of Childhood Illness	.08			−.06			−.01		
Summary Statistics for Step		.034*	.034*		.006	.006		.014	.014
Step II.									
Adolescent Romantic Relationship Intensity (Ages 17–19)	.15*	.023*	.057*	−.11	.003	.019	.24***	.059***	.073**

Note:

***
p < .001.

**
p .01.

*
p < .05. β weights are from final models.