

The Influence of Dyadic Coping on Inflammation in the Context of Chronic Parenting Stress

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## **ABSTRACT**

### **The Influence of Dyadic Coping on Inflammation in the Context of Chronic Parenting Stress**

Sabrina Scarcello

Social relationships are postulated to benefit health through direct and stress-buffering effects. Positive dyadic coping, a spousal support process in which a couple works together to cope with the stressors that one or both partners are facing, is associated with reduced psychological distress. The goal of the present study was to evaluate the association between dyadic coping and inflammation, which is elevated under chronic stress and increases risk for health threats. It was hypothesized that positive dyadic coping would buffer the impact of chronic stress on perceived stress, and in turn reduce inflammation. Forty-four parents of children with an Autism Spectrum Disorder completed questionnaires that assessed relationship satisfaction, social support, and dyadic coping. Daily diaries assessed the occurrence of child behavior problems. Circulating C-reactive protein (CRP) was assessed using ELISA on dried blood spots. Hierarchical linear regression models evaluated the main and interactive effects of child behavior problems, and positive and negative dyadic on circulating CRP. Moderated mediation analyses evaluated the conditional indirect effect of dyadic coping on circulating CRP through perceived caregiving burden. Positive dyadic coping, but not negative dyadic coping, was uniquely associated with circulating CRP. Positive dyadic coping, but not negative dyadic coping buffered the impact of chronic stress on perceived caregiving burden. However, perceived stress did not explain the association between positive dyadic coping and inflammation. These data suggest that positive dyadic coping is a unique interpersonal process that reduces psychological distress and inflammation. Future research should evaluate interventions aimed at improving positive dyadic coping and inflammation among couples experiencing chronic stress.

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## **The Influence of Dyadic Coping on Inflammation in the Context of Chronic Parenting Stress**

It is well-documented that social relationships have an independent effect on mortality, and the effect conferred by social connections is comparable to traditional risk factors including physical inactivity, smoking, and obesity (Holt-Lunstad, Smith, & Layton, 2010; Robles, Slatcher, Trombello, & McGinn, 2014). Psychological stress and social support are closely associated with health (Uchino, 2006). Theoretical models of social relationships and physical health postulate that social relationships influence physiological processes through either main or stress-buffering effects (Cohen, 2004). Global measures of marital satisfaction have been associated with reduced risk for mortality and altered physiological stress responses (Kiecolt-Glaser & Newton, 2001; Robles & Kiecolt-Glaser, 2003). However, previous studies have not revealed the specific aspects of relationship functioning that are beneficial for health (Uchino, Bowen, Carlisle, & Birmingham, 2012). Dyadic coping, a spousal support process in which a couple works together to cope with the stressors that one or both partners are facing, is uniquely associated with reduced psychological distress (Bodenmann, 2005). Accordingly, dyadic coping may be a unique interpersonal process with respect to the ways that social relationships benefit health.

### **Chronic Stress, Dyadic Coping, and Marital Quality**

In Bodenmann's (2005) systemic-transactional theory of stress and coping among couples, dyadic stress is conceptualized as a stressful event or encounter that always concerns both partners, either directly due to a common stressor or indirectly as a result of the individual stress of each partner. Bodenmann's dyadic stress model (2005) postulates that chronic external daily stress (e.g., work stress, parenting stress) is associated with increases in internal dyadic stress (e.g., spousal argument, conflict), which in turn increases psychological distress and



decreases marital satisfaction (Bodenmann, Ledermann, & Bradbury, 2007; Bodenmann, Meuwly, Bradbury, Gmelch, & Ledermann, 2010; Ledermann, Bodenmann, Rudaz, & Bradbury, 2010).

Chronic external daily stressors represent constant drains on the marital relationship, and are more detrimental to marital quality than acute or time-limited stressors (Karney, Story, & Bradbury, 2005). The stress spillover from one life domain to another has been documented in several studies, with work stress often creating additional home stress (Bolger, DeLongis, Kessler, & Wethington, 1989; Grzywacz, Almeida, & McDonald, 2002; Repetti, 1989). In daily diary studies, a greater frequency of daily stressors has been related to greater dyadic stress in the form of negative spousal conflict (Halford, Gravestock, Lowe & Scheldt, 1992; Schulz, Cowan, Cowan, & Brennan, 2004; Story & Repetti, 2006). During periods of high external stress, spouses report more negative evaluations of daily relationship experiences (e.g., time together, affection, support), and are more reactive to these experiences, such that they are strongly related to daily perceptions of relationship satisfaction (Neff & Karney, 2009). These results suggest that external stress negatively impacts marital interaction and the capacity to engage spousal support skills during periods of chronic stress (i.e., recurring external stress) might be critical for reducing psychological distress among couples.

In view of the threat posed by stress on the marital relationship, Bodenmann (2005) postulates that dyadic coping is a spousal support process in which a couple works together to cope with the stressors that one or both partners are facing. Bodenmann further proposes that dyadic coping, in contrast to social support, is a commitment of both partners to assure each others' satisfaction and well-being, which in turn assures the maintenance of the relationship. Bodenmann distinguishes both positive and negative forms of dyadic coping. Positive dyadic

coping includes *supportive dyadic coping* when one partner assists the other in dealing with a stressor through problem- and emotion-focused strategies, such as providing practical advice or expressing solidarity with the partner. In *delegated dyadic coping*, one partner takes over the responsibilities of the other in order to reduce the stress experienced by the partner. In *common dyadic coping*, both partners participate in the coping process together or complementarily in order to handle a common stressor by engaging in problem- and emotion-focused joint coping strategies. Negative dyadic coping refers to hostile, ambivalent or superficial responses when either partner solicits spousal support.

Dyadic coping is a key spousal support process in the maintenance of marital satisfaction over time (Bodenmann, 1997, 2005). Marital interaction studies demonstrate that spousal support behaviour (i.e., support provision and solicitation) is a more robust predictor of longitudinal changes in marital satisfaction than negative and hostile behaviours during marital problem-solving discussions (Pasch & Bradbury, 1998; Sullivan, Pasch, Johnson, & Bradbury, 2010). Furthermore, in cross-sectional and longitudinal studies, self-reported positive dyadic coping was associated with less perceived stress and was a robust predictor of marital satisfaction and dissolution, independent of other communication and conflict behaviours (e.g., expressions of love, interest, anger, and criticism) (Bodenmann, 2005; Bodenmann, Bradbury, & Pihet, 2008; Bodenmann & Cina, 2006; Bodenmann, Pihet, & Kayser, 2006; Hilpert, Bodenmann, Nussbeck, & Bradbury, 2013). Indeed, it has been argued that emphasis should be directed to alternative interpersonal and affective domains (e.g., social support, positive affect) and contextual factors (e.g., stressors, life transitions) in prediction of marital distress, as opposed to communication and problem-solving behaviours, which have been traditionally targeted in marital interaction research and theory (Bodenmann & Shantinath, 2004; Bradbury & Karney, 2004; Bradbury &

Lavner, 2012; Fincham & Beach, 1999; Johnson et al., 2005). Collectively, these data support a shift to considering both interpersonal processes and external circumstances of a marriage, and suggest that the use of dyadic coping strategies may reduce the impact of external daily stress on psychological distress for both marital partners.

Studies have evaluated dyadic coping among couples experiencing increased stress (e.g., chronic illness), and further demonstrate the role of dyadic coping in decreasing psychological distress. High positive dyadic coping and low negative dyadic coping were associated with less psychological distress and greater quality of life among couples in which one member had chronic obstructive pulmonary disease (Meier, Bodenmann, Mörgeli, & Jenewein, 2011). Badr, Carmack, Kashy, Cristofanilli, and Revenson (2010) reported that common dyadic coping was uniquely associated with less distress among partners of patients with metastatic breast cancer, and was associated with greater relationship satisfaction for both partners. Importantly, in randomized intervention studies, the Couples Coping Enhancement Training (CCET), a marital distress prevention program developed to enhance dyadic coping strategies, was effective in increasing marital satisfaction and in reducing psychological distress among long-term couples reporting low levels of marital quality and with spouses experiencing depression (Bodenmann & Shantinath, 2004; Bodenmann et al., 2008; Ledermann, Bodenmann, & Cina, 2007; Widmer, Cina, Charvoz, Shantinath, & Bodenmann, 2005). Collectively, these findings demonstrate the importance of dyadic coping in dealing with stressors that impact both members of the marital dyad.

### **Social Relationships and Health**

Both the structure of social networks (e.g., social integration) and the functions of social relationships (e.g., social support) influence physical health (Uchino, 2006). Social integration

refers to participation in a broad range of social roles, including a sense of identity with these roles (Cohen, 2004). Social support is conceptualized as the psychological and material resources that are provided by a social network in order to help an individual cope with stress (Cohen, 2004).

Social relationships are postulated to benefit health through a stress-buffering mechanism and through main effects on physical health. In the stress-buffering model, the perception that needed support will be available is hypothesized to enhance one's perceived ability to cope with stress, reduce threatening appraisals of demands, and decrease their impact (Cohen, 2004; Cohen & Wills, 1985). Perceived social support may also attenuate emotional and physiological responses to stress or decrease maladaptive behavioural responses (e.g., smoking, illicit drug use) (Cohen, 2004). Accordingly, the stress-buffering model predicts that perceived social support benefits health solely during periods of stress (Cohen, 2004). In contrast, the main-effect model posits that social connections are salutary for health independent of stress. Social networks exert controls that influence normative health behaviours, and also promote positive psychological states (e.g., identity, purpose, positive affect), which in turn influence physiological responses (Cohen, 1988; Thoits, 1986; Uchino, Cacioppo, & Kiecolt-Glaser, 1996). Social integration operates predominately through main effects on health, notably mortality (Cohen, 2004; Wills & Ainette, 2012).

Support from a romantic partner is of primary significance for adjustment to stressful circumstances. The degree of social support perceived within an intimate relationship is a more important predictor of psychological well-being than marital status alone (Ross, 1995). In accordance with the stress-buffering model, dyadic coping is a spousal support process that buffers romantic partners from the impact of external chronic stress, and thus may also benefit

the physical health of both partners. Bodenmann (2005) proposes that in situations in which one partner's individual coping resources are insufficient or when both partners are confronted with the same stressor, dyadic coping should help to mitigate stress for both partners. Further, dyadic coping is postulated to foster a sense of *we-ness*, that is, the perception that the relationship is an available resource during stressful circumstances. Indeed, recent models of social support and health emphasize consistent supportive behaviours in times of stress as key contributors to the beneficial effects of intimate relationships on health (Cutrona, Russell, & Gardner, 2005).

### **Social Support, Inflammation, and Health**

There is growing evidence that social relationships influence inflammation, providing a physiological pathway through which social relationships influence health (Kiecolt-Glaser, Gouin, & Hantsoo, 2010). Inflammation is a critical immune response to infection or injury; however, excessive inflammation is implicated in several diseases. Elevated inflammatory markers, such as C-reactive protein, are strong independent predictors of age-related diseases including cardiovascular disease, type II diabetes, arthritis, and Alzheimer's disease (Black, 2006; Ershler & Keller, 2000; Ridker, 2009). Greater perceived social support has been associated with lower circulating inflammatory markers (Costanzo et al., 2005; Friedman et al., 2005; Lutgendorf et al., 2005; Mezuk, Diez Roux, & Seeman, 2010). Social conflict and interpersonal stress have been related to higher levels of circulating inflammatory markers (Chiang, Eisenberger, Seeman, & Taylor, 2012; Davis et al., 2008; Yang, Schorpp, & Harris, 2014). Furthermore, caregiving is as a chronic interpersonal stressor that is associated with chronic low grade inflammation (Gouin, Hantsoo, & Kiecolt-Glaser, 2008; Kiecolt-Glaser et al., 2010).

In accordance with the broad literature on interpersonal stress and inflammation, marital distress influences inflammatory processes (Jaremka, Glaser, Malarkey, & Kiecolt-Glaser, 2013; Kiecolt-Glaser & Newton, 2001; Phillips et al., 2006; Robles & Kiecolt-Glaser, 2003). In marital interaction studies, negative and hostile behaviours during marital conflict discussions have been associated with immune dysregulation, including acute increases in inflammatory markers (Gouin et al., 2009; Kiecolt-Glaser et al., 1993; Kiecolt-Glaser et al., 1997; Kiecolt-Glaser et al., 2005; Mayne, O’Leary, McCrady, Contrada, & Labouvie, 1997). While the effect of recurrent marital stress on inflammation may increase risk for health threats over time, it has been noted that relatively less empirical work has focused on the positive aspects of the marital relationship (Kiecolt-Glaser & Newton, 2001). Importantly, recent research indicates that positive spousal interactions and perceptions of spousal support are associated with reduced inflammation (Donoho, Crimmins, & Seeman, 2013; Graham et al., 2009; Kasle, Wilhelm, McKnight, Sheikh, & Zautra, 2010; Uchino et al., 2013; Whisman & Sbarra, 2012; Zautra et al., 1998). In accordance with extant data on dyadic coping, reduced psychological distress, and positive trajectories of marital satisfaction, positive and negative dyadic coping may be independently associated with inflammation.

### **Chronic Parenting Stress and the Marital Relationship**

Caring for a child with an Autism Spectrum Disorder (ASD) is associated with greater exposure to daily stressors that form a chronic parenting stress trajectory (Barker, Mailick, & Smith, 2014). Mothers of children with an ASD reported a greater number of daily stressors (e.g., work stress, home stress) across an 8-day period and experienced more days with multiple stressors, compared to mothers of typically developing children (Smith et al., 2010). With respect to child characteristics, child behaviour problems in particular (e.g., self-injury, repetitive

movements) are more strongly associated with parental psychological distress relative to core autism symptoms (e.g., social and verbal communication deficits) (Hartley, Barker, Baker, Seltzer, & Greenberg, 2012; Hastings et al., 2005; Hayes & Watson, 2013; Lecavalier, Leone, & Wiltz, 2006; Lounds, Seltzer, Greenberg, & Shattuck, 2007; Orsmond, Seltzer, Greenberg, & Krauss, 2006).

Importantly, marital satisfaction and positive perceptions of spousal interactions are associated with reduced psychological distress among parents experiencing chronic parenting stress. Marital satisfaction has been found to buffer the impact of parenting stress on psychological distress among parents of children with ASD (Hartley, Barker, Seltzer, Greenberg, & Floyd, 2011; Kersh, Hedvat, Hauser-Cram, & Warfield, 2006; Weitlauf, Vehorn, Taylor, & Warren, 2014). Lickenbrock, Ekas, and Whitman (2011) reported that positive marital interactions (e.g., pleasing physical contact, having a long conversation) were independently associated with maternal emotional well-being on a daily basis, and mediated the influence of positive perceptions of the child on positive affect among mothers of children with an ASD. Collectively, these data support a central role of the marital relationship in buffering the impact of chronic parenting stress, and suggest that dyadic coping may uniquely reduce the impact of chronic parenting stress on psychological distress.

### **Conceptual Model Guiding the Present Study: Dyadic Coping, Chronic Parenting Stress, and Inflammation**

In accordance with growing empirical support for the pivotal role of dyadic coping in perceived stress, and the influence of spousal support on inflammation, the present study will evaluate the effects of positive and negative dyadic coping on inflammation among parents raising a child with an ASD. In line with Bodenmann's (2005) model of dyadic stress and

coping, child behavior problems are conceptualized as recurring daily stressors that are external to the romantic relationship and that can affect both members of the couple simultaneously.

The present study will evaluate the main and stress-buffering effects of positive dyadic coping on inflammation. In line with the stress-buffering model of social relationships and health (Cohen, 2004), positive dyadic coping is hypothesized to buffer the impact of chronic parenting stress on inflammation. Specifically, greater perceptions of positive dyadic coping may alter appraisals of existing stressors (i.e., child behaviour problems), consequently reducing their effective stress (i.e., perceived caregiving burden) and impact on inflammation. It is hypothesized that reduced psychological distress (i.e., perceived caregiving burden) will mediate the stress-buffering effect of positive dyadic coping on inflammation, which will be evaluated using a moderated mediation model. In contrast, negative dyadic coping is predicted to be associated with elevated inflammatory markers. The interaction between child behavior problems and negative dyadic coping will evaluate their combined effect on inflammation; it is predicted that negative dyadic coping will exacerbate the impact of chronic parenting stress on inflammation.



## **Method**

### **Participants**

Participants were biological or legal parents currently living with a child diagnosed with an ASD. Parents were recruited from public and private schools as well as local community organizations and support groups in Montreal for families of children with developmental disabilities. Parents were excluded from the present study if they were pregnant or nursing, because these are factors that are known to influence inflammation. Participants were screened for major medical conditions that could influence inflammation (e.g., rheumatoid arthritis, cancer), and were excluded from the study. Minor medical illnesses were controlled for in statistical analyses.

Parents contacted the research laboratory directly to obtain further information about the study or were contacted by a research assistant through phone and email to provide further information about the study and to determine eligibility. Once eligibility was ascertained, participants were sent an email with links to online questionnaires or were mailed paper versions of the questionnaires (described below). All participants provided consent prior to beginning a background questionnaire. Five participants were excluded due to non-adherence to the study protocol.

### **Procedure**

Participants completed a background questionnaire that assessed basic socio-demographic characteristics, the child's diagnostic and problematic behaviors, caregiving burden, social support, relationship satisfaction, and dyadic coping. For six consecutive days,

participants completed a daily diary questionnaire at the end of the day. The daily diary included questions on the occurrence of child behaviour problems.

Participants had the option of completing electronic or paper versions of the background and daily diary questionnaires. Participants completed the background questionnaire within a week of completing the daily diaries. On the first day of the daily diary period (Sunday), a research assistant contacted participants to complete the diary with them over the phone. Participants had the option of continuing to complete the daily diaries over the phone with a research assistant or completing the diaries independently for the remainder of the study. Participants were asked to complete the diaries at approximately the same time, and were advised to divide the day into segments (i.e., morning, lunch time, afternoon, supper time, evening, night) in order to facilitate recollection of events that occurred throughout the previous 24 hours.

On the final day of the daily diary period, participants met with a research assistant at Concordia University or a local support group between 2 and 6 pm to provide a blood sample and complete the final daily diary. Blood samples were collected within the same time frame to control for diurnal variation in circulating inflammatory markers (O'Connor et al., 2009). In accordance with the protocol developed by McDade, Burhop, and Dohnal (2004), blood spot samples were obtained from all participants by a finger prick. A lancet was used to create a puncture on the index finger and five blood spot samples were collected using a protein filter card. The blood samples remained in room temperature to dry for 24 hours before being transferred to a laboratory freezer. Blood samples were frozen at  $-20^{\circ}\text{C}$  and shipped on dry ice to the Proteomics Laboratory at Rush University Medical Center (Chicago, IL) for processing. Anthropomorphic measurements were completed following the collection of blood samples to

derive body mass index (BMI). Height was measured using a tape measure and weight was measured using an electronic scale. Participants received a remuneration of \$30 upon completion of the study. The study protocol was approved by the Research Ethics Committee at Concordia University.

## Measures

**Dyadic Coping Inventory.** The positive and negative dyadic coping subscales from the English and French versions of the Dyadic Coping Inventory (DCI) were used in the present study (Bodenmann, 2008; Ledermann et al., 2010). The English and French versions are a literal translation of the original German DCI. The translations were carried out by native English and French speakers and backtranslations were completed by native German speakers (Ledermann et al., 2010). The DCI is a self-report questionnaire that was developed in accordance with Bodenmann's theory of dyadic coping in romantic relationships (Bodenmann, 1997). The DCI measures one's own as well as one's perceptions of one's partner's dyadic coping when one or both partners are stressed. The items were rated on a 5-point Likert scale (1 = *very rarely*, 2 = *rarely*, 3 = *sometimes*, 4 = *often*, 5 = *very often*), with higher ratings reflecting greater perceptions of dyadic coping. The positive dyadic coping subscale assessed the degree of positive forms of dyadic coping by oneself and one's partner (i.e., supportive and delegated dyadic coping) (14 items) as well as perceptions of the couple's common dyadic coping strategies (5 items) as described in the introduction. In accordance with previous studies, a composite measure of positive dyadic coping was computed by summing responses to the items that assessed positive dyadic coping (Cronbach's  $\alpha = .95$ ). Previous studies including the French and English versions of the positive dyadic coping subscales revealed adequate internal consistency (Cronbach's  $\alpha = .76-.89$ ) (Ledermann et al., 2010; Levesque, Lafontaine, Caron, &

Fitzpatrick, 2014). The negative dyadic coping subscale is comprised of eight items that assess one's own as well as one's partner's hostile, ambivalent, and superficial responses when either partner is experiencing stress. A total score of negative dyadic coping was computed by summing responses to the eight items (Cronbach's  $\alpha = .86$ ). Previous studies have revealed Cronbach's alpha for the negative dyadic coping subscale from .53-.85 (Ledermann et al., 2010; Levesque et al., 2014).

**Social Support.** The Multidimensional Scale of Perceived Social Support (MSPSS) assessed levels of perceived social support across different relationships (Zimet, Dahlem, Zimet, & Farley, 1988). The 12 items from the MSPSS were used and the 7-point Likert scale was adapted in the present study. Participants rated items on a Likert scale from 1 "Strongly Disagree" to 5 "Strongly Agree". The subscale total scores representing perceived support from family, friends, and a special person were summed to create a composite score of perceived social support (Cronbach's  $\alpha = .89$ ). Cronbach's alpha for the total score has been reported from .84-.92 in community samples (Zimet, Powell, Farley, Werkman, & Berkoff, 1990).

**Relationship Satisfaction.** The Couple Satisfaction Index (CSI) was used to assess relationship satisfaction (Funk & Rogge, 2007). The 16-item version of the CSI was used in the present study. Ratings were made on 6-point Likert-type scales, with higher ratings reflecting greater perceptions of relationship satisfaction. A total score was computed by summing responses to the sixteen items (Cronbach's  $\alpha = .99$ ). The CSI had excellent internal consistency in a community sample of married and dating adults (Cronbach's  $\alpha = .98$ ) (Funk & Rogge, 2007). The CSI demonstrated strong convergent and construct validity, and enhanced power for discriminating among satisfaction groups compared to alternative measures, with 51.5 serving as a cut-score for marital distress (Funk & Rogge, 2007).

**Child Behaviour Problems.** The Problem Behaviour Scale from the Scales of Independent Behaviour-Revised was used to assess child behaviour problems (SIB-R; Bruininks, Woodcock, Weatherman, & Hill, 1996). The Problem Behaviour Scale includes eight problem behaviour categories (e.g., unusual or repetitive habits, socially offensive behaviour, disruptive behaviour), in which behaviours are rated according to frequency of occurrence and severity within the past six months. The eight categories from the Problem Behaviour Scale were used in the present study. On each day of the daily diary period, participants reported the presence of behaviour problems from each of the eight categories within the previous 24 hours using dichotomous response options (i.e., yes/no). The average number of child behaviour problems reported across days during the daily diary period was computed (mean  $\alpha = .69$ ). The General Maladaptive Index from the Problem Behaviour Scale had good test-retest reliability ( $r = .87$ ) in a sample of children from ages 6 to 19 years ( $M = 13.6$  years) with conduct disorders (Bruininks et al., 1996). Bruininks and colleagues (1996) reported that the General Maladaptive Index had good inter-rater reliability ( $r = .84$ ) and demonstrated good construct validity.

**Caregiving Burden.** The Zarit Burden Interview (ZBI) was used to assess caregiving burden (Whitlatch, Zarit, & von Eye, 1991; Zarit, Todd, & Zarit, 1986). The ZBI was designed to assess the stresses experienced by family dementia caregivers. The 22-item version of the ZBI was adapted by replacing 'your relative' with 'your child' in each item. Participants responded to 21 items from the ZBI assessing the subjective impact of caregiving on their life. For each item, participants rated how often they felt that way on a 5-point Likert scale (0=*never*, 1=*rarely*, 2=*sometimes*, 3=*quite frequently*, 4=*nearly always*). A total score was computed by summing responses to the 21 items, with higher scores reflecting greater perceptions of caregiving burden (Cronbach's  $\alpha = .93$ ). Adaptations of the ZBI have demonstrated high internal consistency

among parents of children with an ASD (Cronbach's  $\alpha = .88$ ) (Kring, Greenberg, & Seltzer, 2010).

**C-Reactive Protein.** Dried blood spot (DBS) CRP was measured using the CRP High-sensitivity enzyme-linked immunosorbent assay (ELISA) kit (DRG International, Inc, NJ, USA, Cat# EIA-3954) and followed the manufactured recommended protocol (McDade et al., 2004; McDade, Williams, & Snodgrass, 2007). Standards for CRP blood spots were prepared by diluting CRP standard (80mg/L, Pointe Scientific, Inc. MI USA) with washed erythrocytes in PBS for 20mg/L, 10mg/L, 5mg/L, 2.5mg/L, 1mg/L, 0.5mg/L, 0.025mg/L, and 0 mg/L CRP concentration followed by application onto filter paper for drying. One 3.2-mm disk from each blood spot sample, controls, and standards were extracted with 250  $\mu$ L of PBS containing 0.25% Tween20 detergent overnight in cold room with shaking. Ten  $\mu$ L of the extracted sample, controls, and standards were added to duplicate well. One hundred  $\mu$ L of enzyme conjugate reagent was added and incubated at room temperature for 45 minutes. Wells were washed and incubated with chromogenic substrate to develop colour for 20 minutes and the reaction was stopped by adding acid. The plates were read with ELISA reader at 450 nm. Blood spot calibrators, controls, and samples were included in all assays and were treated identically throughout the protocol. The average intra-assay coefficient of variation was <5% and the inter-assay coefficient of variation was <7.5%.

**Covariates.** Participants provided basic socio-demographic information in the background questionnaire, including age and ethnicity. Ethnicity was coded as a dichotomous variable, with "0" representing Caucasian and "1" representing all other ethnic groups. A dichotomous variable representing the presence of medical conditions reported in the background questionnaire as assessed by the Older Adult Resources and Services

Multidimensional Functional Assessment Questionnaire (OARS) was also entered as a covariate (Fillenbaum & Smyer, 1981). Body mass index was computed as weight (kg) divided by height (m<sup>2</sup>). These variables have been shown to co-vary with inflammation and thus were controlled for in statistical analyses (O'Connor et al., 2009).

**Child Characteristics.** Participants provided information about their child in the background questionnaire, including mental health and medical diagnoses that had been provided by a health care professional. Autism symptoms were assessed by the Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003). The SCQ is a 40-item screening questionnaire covering the areas of language and communication, reciprocal social interaction, and restricted and repetitive behaviours and interests. Eighteen items from the SCQ assessing current behaviours were used in the present study. Participants rated items using dichotomous response options, with “1” indicating the presence of the behaviour. A total score was computed by summing item responses (Cronbach's  $\alpha = .59$ ). The SCQ total score has been reported to have high internal consistency (Cronbach's  $\alpha = .90$ ) (Berument, Rutter, Lord, Pickles, & Bailey, 1999). A total score of 15 has been recommended as a clinical cut-off for differentiating pervasive developmental disorders, including autism, from other neurodevelopmental disorders, with sensitivity and specificity values of .85 and .75, respectively (Berument et al., 1999).

### **Statistical Analyses**

Hierarchical multiple regression analyses assessed the main and interactive effects of child behavior problems, and positive and negative dyadic coping on circulating CRP. The distribution of raw CRP values was positively skewed, and thus, a base 10 logarithmic transformation was applied to normalize the CRP distribution. Hierarchical linear regression

models were fitted with the following covariates: age, sex, ethnicity, BMI, and medical conditions. Additional regression models included social support and relationship satisfaction as covariates to evaluate whether positive and negative dyadic coping were uniquely associated with circulating CRP. Interaction terms among child behaviour problems and dyadic coping were added in another set of hierarchical regression models to evaluate the moderating effect of dyadic coping on the relation between child behaviour problems and CRP. All interaction terms were created with centered, continuous independent variables. When significant, interactions were probed using simple slope analysis (Aiken & West, 1991). To test the hypothesis that the indirect effect of child behaviour problems on CRP through caregiving burden is moderated by dyadic coping, a test of moderated mediation was conducted using Hayes' (2011) SPSS macro with bootstrapping (MODMED) with positive dyadic coping specified as a moderator of the association between child behaviour problems and caregiving burden. The moderated mediation effect was tested by showing that the conditional indirect effect of child behaviour problems on CRP through caregiving burden was significantly different from zero using normal-theory tests. A parametric bootstrapping resampling procedure with bias corrected confidence intervals was used to test the significance of the conditional indirect effect. A two-tailed .05 alpha level was used for the study. All statistical analyses were conducted using IBM Statistical Package for the Social Sciences (SPSS) version 22.



## Results

Sixty-seven parents participated in the study. Fifty-one participants endorsed that they were currently in a romantic relationship. Five blood samples were lost during blood sample processing, and thus, CRP data was only available for forty-six participants. Two participants were excluded due to CRP concentrations greater than 10 mg/L, which is indicative of acute infection, and thus, would prevent detection of stress-related changes in CRP (Pearson et al., 2003). Therefore, the final sample for the present analyses consisted of forty-four participants.

Socio-demographic and health characteristics of study participants are listed in Table 1 and child characteristics are listed in Table 2. Correlations between the covariates and independent variables are listed in Tables 3 and 4. There was a moderate negative correlation between positive and negative dyadic coping ( $r = -.68$ ). Thirty-four participants (77.3%) completed six days, three (6.8%) completed five days of daily diaries, and seven (15.9%) completed four days of daily diaries.

Table 1

*Sociodemographic and Health Characteristics of Study Participants (N = 44)*

Characteristic	<i>n</i> (%), <i>M</i> ± <i>SD</i>
Sex	
Female	34 (77.3)
Age (years)	42.57 ± 6.19
Ethnicity	
Caucasian	28 (63.6)
Middle Eastern	4 (9.1)
Latin American	3 (6.8)
Aboriginal	2 (4.5)
Black	2 (4.5)
South Asian	1 (2.3)
Bi-racial	4 (9.1)
C-reactive protein (mg/L)	1.05 ± 1.24
Body mass index (kg/m <sup>2</sup> )	27.27 ± 5.08
Medical conditions	
One medical condition	12 (27.3)
Two medical conditions	3 (6.8)
Native language <sup>a</sup>	
French	19 (46.3)
English	9 (22)
Other	13 (31.7)
Education <sup>b</sup>	
≤ High school	7 (16.3)
College	11 (25.6)
≥ Bachelors degree	25 (58.2)
Income	
<\$20 000	5 (11.4)
\$20 000 - \$49 999	7 (15.9)
\$50 000 - \$69 999	13 (29.5)
\$70 000 - \$89 999	9 (20.5)
\$90 000 - \$119 999	5 (11.4)
\$120 000 - \$160 000	5 (11.4)

Note. <sup>a</sup>*n* = 41. <sup>b</sup>*n* = 43.

Table 2

*Child Characteristics*

Characteristic	<i>n</i> (%), <i>M</i> ± <i>SD</i>
Sex	
Male	34 (77.3)
Age (years)	10.89 ±4.66
Diagnoses	
Autism	34 (77.3%)
PDD	6 (13.6%)
Asperger's syndrome	4 (9.1%)
Child age at diagnosis	4.82 (3.65)
Intellectual disability	
No	26 (59.1)
Yes	18 (40.9)
Other mental health diagnoses <sup>a</sup>	
Anxiety disorder	10 (22.7)
ADHD	10 (22.7)
OCD	4 (9.1)
Other medical diagnoses	
One medical condition	7 (15.9)
Two medical conditions	2 (4.5)

*Note.* PDD = Pervasive Developmental Disorder; ADHD = Attention Deficit Hyperactivity Disorder; OCD = Obsessive Compulsive Disorder

<sup>a</sup>*n* = 17.

Table 3

*Summary of Intercorrelations, Means, and Standard Deviations for CRP, Participant, and Child Characteristics*

Measure	1	2	3	4	5	6	<i>M</i>	<i>SD</i>	<i>Range</i>
1. CRP	—	.09	.43**	-.10	.20	-.04	1.05	1.24	0.08-5.91
2. Age		—	-.06	.57**	.69**	-.07	42.57	6.19	31-57
3. BMI			—	-.07	-.01	.06	27.27	5.08	19.47-40.21
4. Child age				—	-.21	-.11	10.89	4.66	3-21
5. Age at child birth					—	.01	31.30	5.17	23-46
6. Autism symptoms (SCQ)						—	8.84	2.73	4-16

*Note.* CRP = base 10 log-transformed C-reactive protein (mg/L); BMI = body mass index (kg/m<sup>2</sup>); SCQ = Social Communication Questionnaire

\* $p < .05$ . \*\* $p < .01$ .

Table 4

*Summary of Intercorrelations, Means, and Standard Deviations for CRP, Dyadic Coping, Social Relationships, Daily Child Behaviour Problems, and Caregiving Burden*

Measure	1	2	3	4	5	6	7	<i>M</i>	<i>SD</i>	<i>Range</i>
1. CRP	—	-.25†	.02	-.13	-.11	.12	.01	1.05	1.24	0.08-5.91
2. Positive DC (DCI)		—	-.68**	.44**	.74**	-.20	-.19	68.52	14.70	37-95
3. Negative DC (DCI)			—	-.26†	-.65**	.08	.33*	15.20	5.73	8-27
4. Social support (MSPSS)				—	.33*	-.13	-.04	47.41	9.19	24-60
5. Relationship satisfaction (CSI)					—	.02	-.11	58.68	20.25	5-81
6. Average daily child behaviour problems (SIB-R)						—	.52**	2.07	1.46	0-6.50
7. Caregiving burden (ZBI)							—	37.41	16.55	5-78

*Note.* CRP = base 10 log-transformed C-reactive protein (mg/L); DCI = Dyadic Coping Inventory; MSPSS = Multidimensional Scale of Perceived Social Support; CSI = Couple Satisfaction Index; SIB-R = Scales of Independent Behaviour-Revised; ZBI = Zarit Burden Interview

† $p < .10$ . \* $p < .05$ . \*\* $p < .01$ .

### Main Effect of Dyadic Coping on CRP

The first model evaluated the main effects of positive and negative dyadic coping on circulating CRP. Table 5 contains the results of regression analyses of CRP on positive and negative dyadic coping. Adjusting for the covariates of age, sex, ethnicity, BMI, and self-reported medical conditions, positive dyadic coping was associated with lower circulating CRP,  $b = -.01$  ( $SE = .01$ ),  $t = -2.46$ ,  $p = .02$ ,  $R^2 = .10$ ,  $sr = -.31$ , but negative dyadic coping was not related to CRP,  $b = -.02$  ( $SE = .01$ ),  $t = -1.52$ ,  $p = .14$ ,  $sr = -.19$ . The relation between positive dyadic coping and CRP is shown in Figure 1.

An additional model evaluated the contributions of positive dyadic coping to circulating CRP above and beyond other social relationship variables (Table 6). Positive dyadic coping remained independently, but statistically marginally associated with lower circulating CRP,  $b = -.01$  ( $SE = .01$ ),  $t = -1.85$ ,  $p = .07$ ,  $R^2 = .06$ ,  $sr = -.24$ , after adjusting for negative dyadic coping,  $b = -.02$  ( $SE = .01$ ),  $t = -1.44$ ,  $p = .16$ ,  $sr = -.19$ , perceived social support,  $b = -.00$  ( $SE = .01$ ),  $t = -.29$ ,  $p = .77$ ,  $sr = -.04$ , and relationship satisfaction,  $b = -.00$  ( $SE = .00$ ),  $t = -.01$ ,  $p = .99$ ,  $sr = -.00$ .

### Moderation of Relation Between Child Behaviour Problems and CRP

The next set of linear regression models evaluated whether dyadic coping moderated the impact of child behavior problems on CRP. Table 7 lists the results of regression analyses of CRP on child behaviour problems and dyadic coping. As shown previously, results indicated that there was a significant main effect of positive dyadic coping,  $b = -.01$  ( $SE = .01$ ),  $t = -2.30$ ,  $p = .03$ ,  $sr = -.29$ , but negative dyadic coping was not associated with circulating CRP,  $b = -.02$  ( $SE = .01$ ),  $t = -1.48$ ,  $p = .15$ ,  $sr = -.19$ . The interaction between child behaviour problems and

positive dyadic coping was not related to circulating CRP,  $b = .00$  ( $SE = .00$ ),  $t = .54$ ,  $p = .60$ ,  $sr = .07$ . Similarly, the interaction between child behaviour problems and negative dyadic coping was not related to circulating CRP,  $b = .00$  ( $SE = .01$ ),  $t = .34$ ,  $p = .74$ ,  $sr = .05$ .<sup>1</sup>

### **Moderation of Relation Between Child Behaviour Problems and Caregiving Burden**

Moderated linear regression analyses were performed using caregiving burden as the outcome as the first step in evaluating the hypothesis that dyadic coping may reduce circulating CRP through reducing perceived caregiving burden. Linear regression models evaluated whether dyadic coping moderated the impact of child behaviour problems on caregiving burden. Table 8 lists the results of regression analyses of caregiving burden on child behaviour problems and dyadic coping. Child behaviour problems were positively associated with caregiving burden in the main effects model,  $b = 6.83$  ( $SE = 1.62$ ),  $t = 4.21$ ,  $p < .001$ ,  $sr = .53$ . Negative dyadic coping was positively associated with caregiving burden,  $b = 1.45$  ( $SE = .53$ ),  $t = 2.73$ ,  $p = .01$ ,  $sr = .34$ , but positive dyadic coping was not significantly related to caregiving burden,  $b = .34$  ( $SE = .21$ ),  $t = 1.61$ ,  $p = .12$ ,  $sr = .20$ .

The interaction between child behaviour problems and positive dyadic coping was significant,  $b = -.27$  ( $SE = .13$ ),  $t = -2.06$ ,  $p = .05$ ,  $sr = -.24$ . The interaction was probed according to the recommendations of Aiken and West (1991), and the plots of simple slopes are depicted in Figure 2. Tests of simple slopes indicated that at a score of one standard deviation below the sample mean on positive dyadic coping, every one unit increase in child behaviour

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<sup>1</sup> The interactions between child behaviour problems and dyadic coping were evaluated in separate regression models and the results remained the same: the interaction between child behaviour problems and positive dyadic coping was not associated with circulating CRP,  $b = .00$  ( $SE = .00$ ),  $p = .62$ ,  $sr = .07$ , and the interaction between child behaviour problems and negative dyadic coping was not related to circulating CRP,  $b = .00$  ( $SE = .01$ ),  $p = .87$ ,  $sr = .02$ .

problems was associated with an increase of 9.21 units on caregiving burden,  $b = 9.21$  ( $SE = 1.93$ ), 95% CI = 5.29-13.13,  $t = 4.77$ ,  $p < .001$ ,  $sr = .61$ . At a score of one standard deviation above the sample mean on positive dyadic coping, child behaviour problems were no longer associated with caregiving burden,  $b = -.36$  ( $SE = 3.24$ ), 95% CI = -6.94-6.23,  $t = -.11$ ,  $p = .91$ ,  $sr = -.01$ . The interaction between child behaviour problems and negative dyadic coping was not significantly related to caregiving burden,  $b = .20$  ( $SE = .27$ ),  $t = .75$ ,  $p = .46$ ,  $sr = .09$ .<sup>2</sup>

### **Moderated Mediation of Dyadic Coping on Relation Between Child Behaviour Problems and CRP Through Caregiving Burden**

To test the hypothesis that the indirect effect of child behaviour problems on CRP through caregiving burden is moderated by dyadic coping, a test of moderated mediation was conducted using Hayes' (2011) SPSS macro with bootstrapping (MODMED). The model tested the conditional indirect effect of child behaviour problems on CRP through caregiving burden, with positive dyadic coping specified as moderating the effect of child behaviour problems on caregiving burden. The results of the moderated mediation analysis with positive dyadic coping are depicted in Figure 3. The results show that there was no conditional indirect effect of child behaviour problems on CRP through caregiving burden moderated by positive dyadic coping,  $b = -.01$  ( $SE = .02$ ), 95%CI = -.08-.03  $z = -.41$ ,  $p = .69$ .

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<sup>2</sup> The interaction between child behaviour problems and dyadic coping were evaluated in separate regression models and the results were unchanged: the interaction between child behaviour problems and positive dyadic coping was associated with caregiving burden,  $b = -.33$  ( $SE = .13$ ),  $p = .02$ ,  $sr = -.32$  and the interaction between child behaviour problems and negative dyadic coping was not associated with caregiving burden,  $b = .42$  ( $SE = .26$ ),  $p = .12$ ,  $sr = .20$ .



Table 5

*Hierarchical Unstandardized Regression Coefficients for C-Reactive Protein on Positive and Negative Dyadic Coping*

Variable	CRP						
	Model 1 <i>b</i>	<i>SE</i>	Model 2		Model 3		95% CI
			<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	
Step 1							
Constant	-1.71	.54**	-1.68	.55**	-1.84	.52**	[-2.89, -.79]
Age	.01	.01	.01	.01	.01	.01	[-.01, .03]
Sex	.22	.13	.22	.14	.20	.13	[-.05, .46]
Ethnicity	-.05	.11	-.05	.12	-.04	.11	[-.26, .18]
BMI	.03	.01*	.03	.01*	.04	.01**	[.02, .06]
Medical conditions	.24	.12*	.25	.12*	.16	.12	[-.08, .40]
Step 2							
Negative DC			.00	.01	-.02	.01	[-.05, .01]
Step 3							
Positive DC					-.01	.01*	[-.02, -.00]
$R^2$	.33		.33		.42		
$\Delta R^2$			.00		.10*		

*Note.* CRP = base 10 log-transformed C-reactive protein; CI = confidence interval; Sex is coded 0=male, 1=female; Ethnicity is coded 0=Caucasian, 1= Other including Black, Asian, South Asian, Middle Eastern, Latin American, Bi-racial; BMI = body mass index (kg/m<sup>2</sup>); Medical conditions is coded 0=no, 1=yes; DC = dyadic coping.

† $p < .10$ . \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

Table 6

*Hierarchical Unstandardized Regression Coefficients for C-Reactive Protein on Dyadic Coping and Social Relationships*

Variable	CRP						
	Model 1 <i>b</i>	<i>SE</i>	Model 2		Model 3		95% CI
			<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	
<b>Step 1</b>							
Constant	-1.71	.54**	-1.84	.57**	-1.88	.55**	[-3.00, -.76]
Age	.01	.01	.01	.01	.01	.01	[-.01, .03]
Sex	.22	.13	.17	.14	.20	.14	[-.08, .47]
Ethnicity	-.05	.11	-.05	.12	-.04	.12	[-.27, .20]
BMI	.03	.01*	.04	.01**	.04	.01**	[.02, .06]
Medical conditions	.24	.12*	.22	.12†	.16	.12	[-.09, .41]
<b>Step 2</b>							
Negative DC			-.01	.01	-.02	.01	[-.05, .01]
Social support			-.01	.01	-.00	.01	[-.02, .01]
Relationship satisfaction			-.00	.00	-.00	.00	[-.01, .01]
<b>Step 3</b>							
Positive DC					-.01	.01†	[-.03, .00]
$R^2$	.33		.37		.43		
$\Delta R^2$			.04		.06†		

*Note.* CRP= base 10 log-transformed C-reactive protein; CI=confidence interval; Sex is coded 0=male, 1=female; Ethnicity is coded 0=Caucasian, 1= Other including Black, Asian, South Asian, Middle Eastern, Latin American, Bi-racial; BMI = body mass index (kg/m<sup>2</sup>); Medical conditions is coded 0=no, 1=yes; DC = dyadic coping.

† $p < .10$ . \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

Table 7

*Hierarchical Unstandardized Regression Coefficients for C-Reactive Protein on Child Behaviour Problems and Dyadic Coping*

Variable	CRP						
	Model 1 <i>b</i>	<i>SE</i>	Model 2		Model 3		95% CI
			<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	
<b>Step 1</b>							
Constant	-1.71	.54**	-1.88	.53**	-1.84	.55**	[-2.97, -.72]
Age	.01	.01	.01	.01	.01	.01	[-.01, .03]
Sex	.22	.13	.19	.13	.20	.14	[-.08, .48]
Ethnicity	-.05	.11	-.03	.11	-.03	.12	[-.27, .21]
BMI	.03	.01*	.04	.01**	.04	.01**	[.02, .06]
Medical conditions	.24	.12*	.17	.12	.18	.13	[-.08, .44]
<b>Step 2</b>							
Child behaviour problems			.02	.04	.03	.05	[-.07, .13]
Negative DC			-.02	.01	-.02	.01	[-.05, -.01]
Positive DC			-.01	.01*	-.01	.01*	[-.02, -.00]
<b>Step 3</b>							
Child behaviour problems x Negative DC					.00	.01	[-.01, .02]
Child behaviour problems x Positive DC					.00	.00	[-.01, .01]
$R^2$	.33		.43		.43		
$\Delta R^2$			.10		.01		

*Note.* CRP= base 10 log-transformed C-reactive protein; CI=confidence interval; Sex is coded 0=male, 1=female; Ethnicity is coded 0=Caucasian, 1= Other including Black, Asian, South Asian, Middle Eastern, Latin American, Bi-racial; BMI = body mass index (kg/m<sup>2</sup>); Medical conditions is coded 0=no, 1=yes; DC = dyadic coping.

† $p < .10$ . \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

Table 8

*Hierarchical Unstandardized Regression Coefficients for Caregiving Burden on Child Behaviour Problems and Dyadic Coping*

Variable	Caregiving Burden						
	Model 1b	SE	Model 2		Model 3		95% CI
			<i>b</i>	SE	<i>b</i>	SE	
<b>Step 1</b>							
Constant	49.93	25.79†	45.06	20.95*	46.55	19.75*	[6.38, 86.72]
Age	-.29	.43	-.04	.36	-.11	.34	[-.80, .58]
Sex	3.38	6.41	-1.10	5.14	-3.96	4.90	[-13.93, 6.02]
Ethnicity	2.75	5.47	7.21	4.51	8.89	4.25*	[.24, 17.53]
BMI	-.17	.55	-.36	.44	-.26	.42	[-1.10, .59]
Medical conditions	2.15	5.71	6.37	4.76	3.53	4.59	[-5.81, 12.86]
<b>Step 2</b>							
Child behaviour problems			6.83	1.62***	4.72	1.72*	[1.22, 8.23]
Negative DC			1.45	.53*	1.47	.51*	[.44, 2.50]
Positive DC			.34	.21	.28	.20	[-.12, .68]
<b>Step 3</b>							
Child behaviour problems x Negative DC					.20	.27	[-.34, .74]
Child behaviour problems x Positive DC					-.27	.13*	[-.54, -.00]
$R^2$	.03			.45		.55	
$\Delta R^2$				.42***		.10*	

*Note.* CI=confidence interval; Sex is coded 0=male, 1=female; Ethnicity is coded 0=Caucasian, 1= Other including Black, Asian, South Asian, Middle Eastern, Latin American, Bi-racial; BMI = body mass index (kg/m<sup>2</sup>); Medical conditions is coded 0=no, 1=yes; DC = dyadic coping.

† $p < .10$ . \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

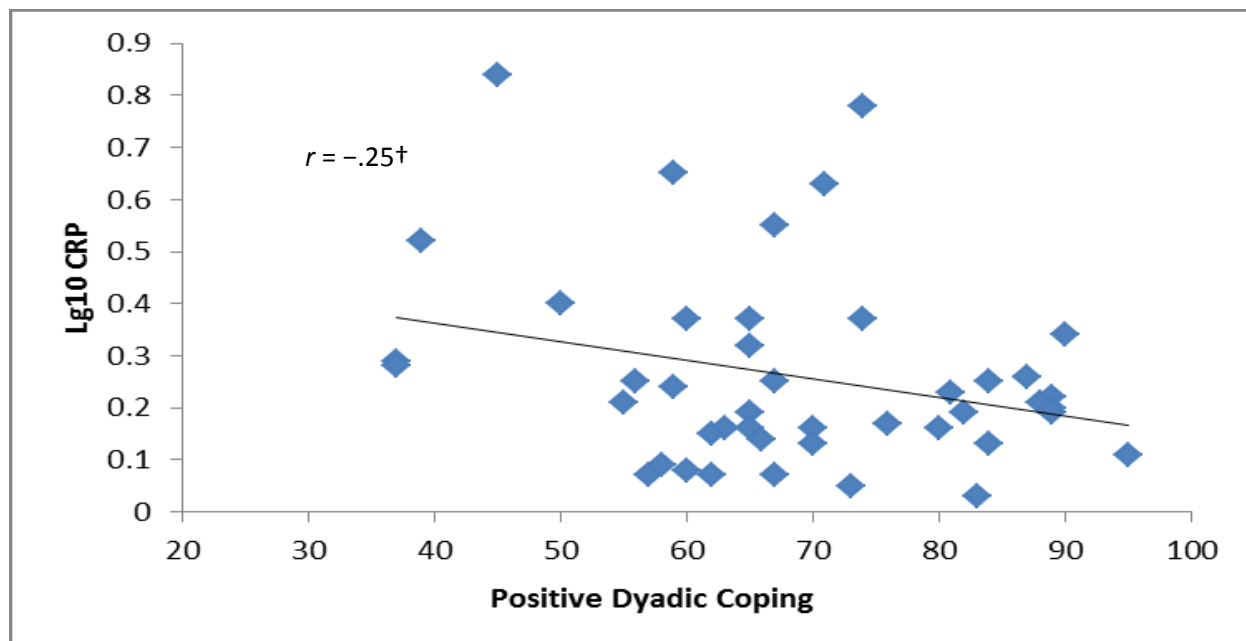
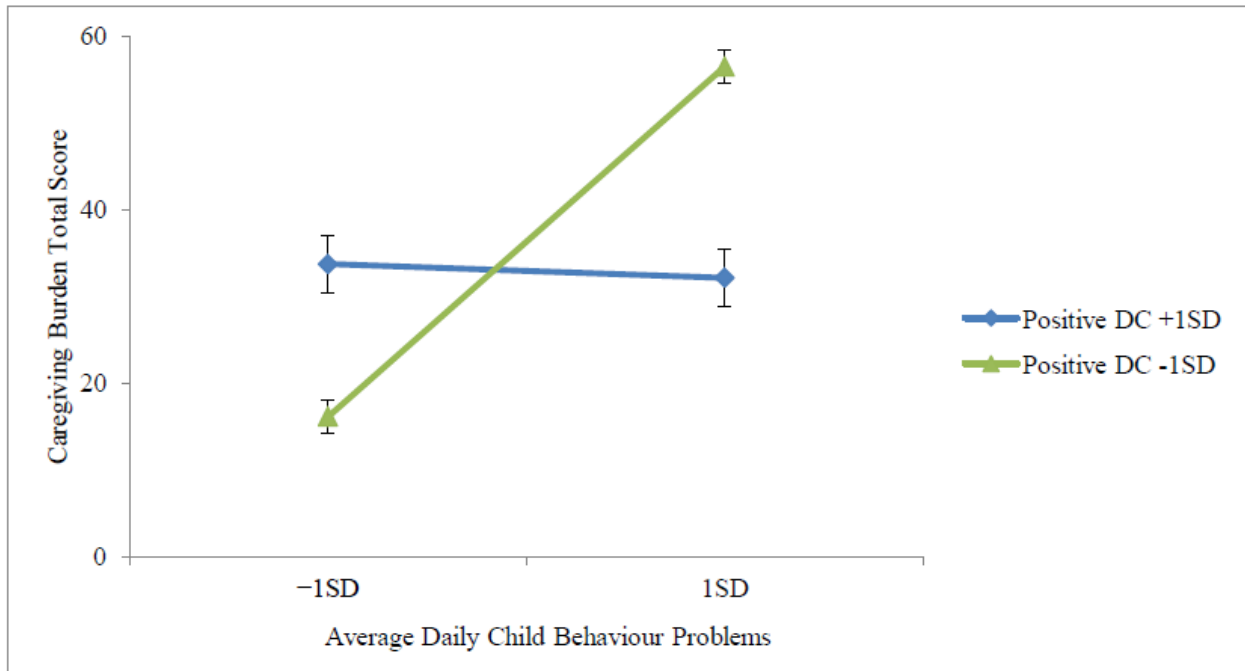
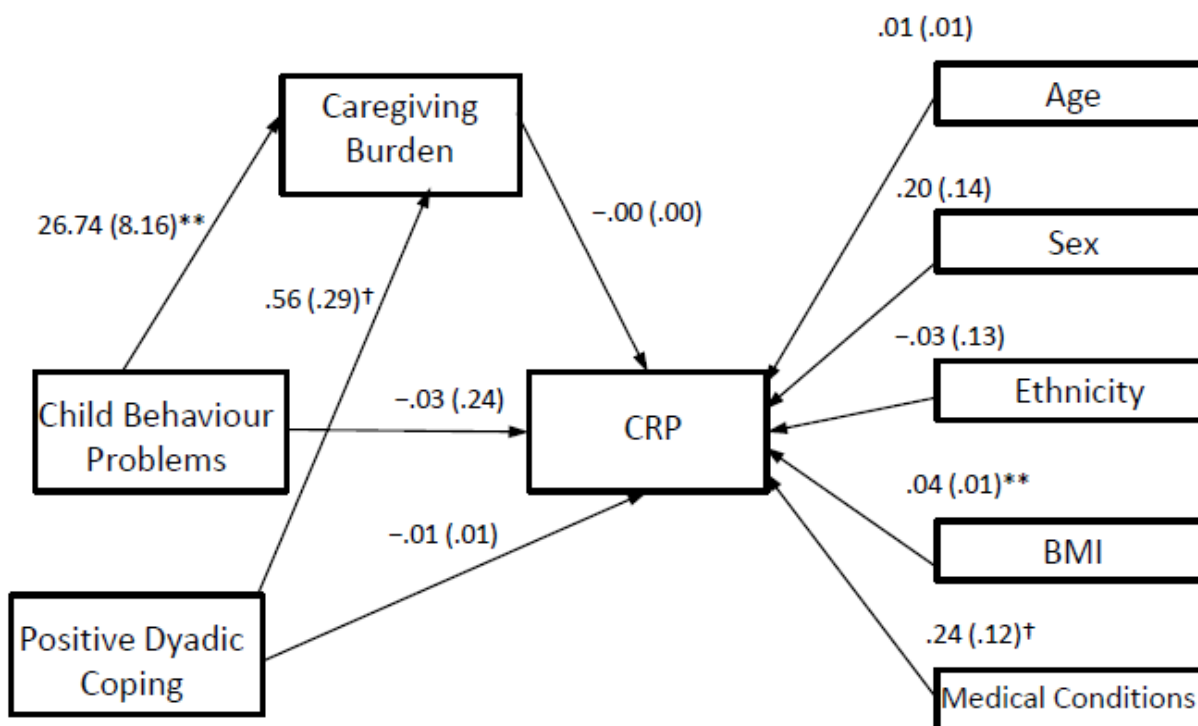


Figure 1. Bivariate relation between positive dyadic coping and C-reactive protein.  
 $^\dagger p < .10$ .



*Figure 2.* Caregiving burden on child behaviour problems and positive dyadic coping. Error bars represent standard errors. DC = dyadic coping.



*Figure 3.* Moderated mediation path model of the conditional indirect effect of child behaviour problems on C-reactive protein through caregiving burden, with positive dyadic coping moderating the path of child behaviour problems on caregiving burden. Estimation of paths with unstandardized regression coefficients and standard errors in parentheses. CRP = C-reactive protein; BMI = body mass index.

† $p < .10$ . \* $p < .05$ . \*\* $p < .01$ .

## Discussion

The goals of the present study were to evaluate the association between two aspects of relationship functioning—positive and negative dyadic coping—and inflammation, and to examine whether dyadic coping moderated the associations between chronic stress (operationalized as recurring child behaviour problems) and inflammation in a sample of chronically-stressed caregivers. Positive dyadic coping, but not negative dyadic coping, was uniquely associated with circulating CRP. The results corroborate the pivotal role of dyadic coping as a predictor of inflammation. Finally, positive dyadic coping, but not negative dyadic coping buffered the impact of chronic stress on perceived caregiving burden. Results indicate, however, that perceived stress did not explain the association between positive dyadic coping and inflammation.

In Bodenmann's systemic-transactional theory of stress and coping, dyadic coping is postulated to be conceptually distinct from social support, as it not an altruistic behaviour, but a commitment of both partners to mitigate stress in order to ensure the well-being of the relationship (Bodenmann, 2005). The present results support the separability of dyadic coping from social support. Dyadic coping reduced the impact of child behaviour problems, which can negatively influence both members of the marital dyad and the marital relationship (Hartley et al., 2010, 2012). Furthermore, dyadic coping, but not social support, was uniquely associated with inflammation. After adjusting for differences in marital relationship satisfaction and perceived social support, positive dyadic coping became marginally associated with circulating CRP, but the change in effect size was trivial, therefore, this change in statistical significance is attributable to the small sample size. Therefore, the present study supports Bodenmann's



conceptualization of dyadic coping as a unique interpersonal process in adjustment to chronic daily stress, and extends its influence to physiological stress responses.

Kiecolt-Glaser and Newton (2001) recommended investigating associations between both positive and negative aspects of the marital relationship and physiological processes, given that most studies had used global measures of marital satisfaction, which may not adequately evaluate positive and negative relationship dimensions. Indeed, in the present study only positive dyadic coping was associated with inflammation. Due to robust associations between marital conflict and physiological changes, much early research focused on negative aspects of relationship functioning (Robles & Kiecolt-Glaser, 2003). In laboratory studies, partners' hostile and negative behaviours during marital problem-solving discussions have consistently been associated with immune dysregulation, including enhanced acute increases in inflammatory markers, compared to socially supportive interactions (Kiecolt-Glaser et al., 1993; Kiecolt-Glaser et al., 1997; Kiecolt-Glaser et al., 2005). Positive behaviours and communication patterns among partners may mitigate physiological responses to acute stress (Graham et al., 2009; Heffner, Kiecolt-Glaser, Loving, Glaser, & Malarkey, 2004; Meuwly et al., 2012). In the present study, participants self-reported on general levels of positive and negative dyadic coping within the relationship. The present results are congruent with recent cross-sectional studies evaluating both spousal support and strain, which revealed that only spousal support was uniquely associated with inflammation (Donoho et al., 2013; Whisman & Sbarra, 2012). Importantly, the present study extends these findings by showing that the process of working collaboratively with a spouse to handle stress benefits inflammation.

It is important to consider how the present sample differed from previous studies on marital functioning and immune function, and may account for the present pattern of results.

Previous reports have been based on couples in relatively satisfied marriages, and thus, the effects of marital conflict on immune function were postulated to be larger than suggested by the data (Kiecolt-Glaser & Newton, 2001; Robles & Kiecolt-Glaser, 2003). Nearly 32% of scores on the Couple Satisfaction Index met the cut-off score for marital distress. Accordingly, within the context of relatively satisfied relationships, the present study revealed that differences in positive dyadic coping are more closely associated with inflammation than negative dyadic coping when contending with stress. Given that parents of children with developmental disabilities may be at greater risk of experiencing declines in marital quality and relationship dissolution over time (Hartley et al., 2010), it would be beneficial to examine changes in relationship satisfaction and positive dyadic coping, and their association with inflammation over time. Recent data and relationship models emphasize consistent socially supportive behaviours, as opposed to marital problem-solving behaviours, as key predictors of marital quality and stability (Cutrona et al., 2005; Sullivan et al., 2010). However, further work is needed to elucidate the influence of positive dyadic coping on inflammation over time.

In accordance with the buffering effect of dyadic coping on marital quality (Bodenmann, 2005), it was hypothesized that dyadic coping may reduce inflammation by moderating the impact of chronic stress on psychological distress. Results indicated that positive dyadic coping buffered the impact of child behaviour problems on caregiving burden, suggesting that objective stressors are perceived as less threatening in the context of high positive dyadic coping. Contrary to hypotheses, analyses indicated that these differences in stress perceptions associated with positive dyadic coping did not translate into reduced circulating CRP, and thus positive dyadic coping's protective effect on inflammation is not through reduced levels of psychological distress.

In view of the associations between chronic stress, psychological distress, and inflammatory markers (Gouin, Glaser, Malarkey, Beversdorf, & Kiecolt-Glaser, 2012; Gouin et al., 2008), it was hypothesized that dyadic coping may exert a stress-buffering effect on inflammation (Cohen, 2004). Results of the present study revealed that a main effect model better accounts for the association between positive dyadic coping and inflammation. It should be noted that this is an area of debate as psychological mechanisms (e.g., perceived stress, depression, positive affect) have generally not been found to mediate links between social support and changes in physiological processes (Uchino et al., 2012). Accordingly, Uchino and colleagues (2012) recommend increasing investigation of specific support contexts (e.g., type of support group member) and expanding conceptualizations of psychological mechanisms beyond perceived stress, depression, and anxiety in order to provide a more sensitive test of links between social support and physical health. The authors also present the contentious perspective that the psychological mechanisms postulated by predominate models of social support and health are inaccurate, and relationships exert direct effects on physical health. The present study represents an important contribution towards testing these competing models of social support and health, and it is evident that future work would benefit from evaluating dyadic concepts of support, the stress/support context, and their links with inflammation.

The present study has several strengths including the use of an ethnically diverse sample of adults contending with varying degrees of chronic daily stressors. The use of a daily measure of child behaviour problems provided an ecologically valid measure of recurrent daily stress, which was less susceptible to retrospective bias (Almeida, 2005). The present study included well-validated measures of social and romantic relationships, providing data to integrate contemporary models of stress, marital functioning, and health.

The present study is cross-sectional; thus, causal inferences about dyadic coping and inflammation are not warranted. Longitudinal measures of positive dyadic coping and inflammation over time would help to determine the directionality of the effect, and contribute to existing inquiry on the relative contribution of marital quality to health (e.g., Robles et al., 2014). The present study included self-reported positive dyadic coping from one member of the couple. Future studies would benefit from including both members of a couple in order to evaluate the effects of one's partner's perceptions of stress and perceived dyadic coping on inflammatory processes of the other partner (e.g., Meuwly et al., 2012). Previous studies have revealed that perceptions of positive dyadic coping from the partner are more influential on women's marital satisfaction compared to that of men (Bodenmann et al., 2006). Perceived spousal support has been found to be associated with circulating inflammatory markers among women, but not men (Donoho et al., 2013). The present study included a predominately female sample, which prevented analyses with gender as a moderator. Future studies should include a greater proportion of men in order to evaluate gender differences in the association between positive dyadic coping and inflammation.

As chronic daily stressors are likely to compromise marital functioning independent of couples' communication skills (Karney et al., 2005), dyadic coping is likely to involve both verbal and non-verbal expressions of stress and support in regular spousal interactions. Furthermore, the frequency of dyadic coping may be an additional factor to examine. Accordingly, it would be advantageous to utilize additional methods of analysis, including daily diary and observational studies, to examine quantitative links between proximal dyadic coping interactions and corresponding changes in immune function. Furthermore, provision and receipt of social support are postulated to have differential links with health, with perceived social

support generally viewed as more salutary for physical health (Uchino, 2009). However, dyadic coping differs in notable ways from social support. In Bodenmann's systemic-transactional model, stress is experienced by both partners, and thus dyadic coping relies on a mutual spousal support process in order to ensure each partner's satisfaction and well-being, which in turn assures the quality and stability of the relationship. Therefore, dyadic coping is postulated to have two goals: stress reduction and enhancement of relationship quality (Bodenmann, 2005). The immediate receipt and provision of dyadic coping, concordant perceptions of positive dyadic coping, and related processes (e.g., intimacy, time together, commitment) may benefit physiological processes. As such, in addition to examining longitudinal associations between dyadic coping and physiological processes, an important direction for future work would be delineating the specific aspects of dyadic coping that prove to have benefits for physiological stress responses.

Results of the present study support the position that marital interventions should incorporate training in dyadic coping, as opposed to merely focusing on communication and problem-solving skills (Bodenmann & Shantinath, 2004). Marital education programs among White middle-class, relatively satisfied couples produced modest effect sizes for communication skills ( $d = .43-.45$ ) and relationship quality ( $d = .30-.36$ ), and few studies have included follow-up assessments beyond 6 months (Hawkins, Blanchard, Baldwin, & Fawcett, 2008). Given that these interventions largely focused on communication skills, it is evident that further improvements can be made. Furthermore, emerging evidence indicates that spousal support skills are more important predictors of longitudinal changes in marital satisfaction than communication skills alone (Pasch & Bradbury, 1998; Sullivan et al., 2010).

The CCET, developed by Bodenmann and colleagues, is distinct from other marital intervention programs due to its emphasis on the impact of daily stress on dyadic communication, and training in enhancing both individual and dyadic coping skills (Bodenmann & Shantinath, 2004). The CCET has been effective in improving dyadic coping and marital satisfaction among couples in long-term relationships with low levels of marital satisfaction (Bodenmann & Shantinath, 2004). Results of the present study suggest that training in positive dyadic coping through the CCET may help to reduce distress and inflammation among couples experiencing chronic stress.

The present study revealed the importance of dyadic coping for both psychological and physiological adjustment in the context of chronic parenting stress. Future work will benefit from incorporating daily and observational measures of positive dyadic coping. The present study highlights fruitful avenues for exploration as part of an important shift in examining the supportive contexts and interpersonal domains that may influence links between marital functioning and health.

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