Published in final edited form as:

J Clin Psychol Med Settings. 2018 December ; 25(4): 441–451. doi:10.1007/s10880-018-9554-y.

Adolescents and Young Adults Living with Congenital Heart Disease: Coping, Stress Reactivity, and Emotional Functioning

Jennifer D. Monti^{1,2}, Jamie L. Jackson^{1,2}, and Kathryn Vannatta^{1,2}

¹Center for Biobehavioral Health, The Research Institute at Nationwide Children's Hospital, 700 Children's Drive, Columbus, OH 43205, USA

²Department of Pediatrics, The Ohio State University College of Medicine, Columbus, OH, USA

Abstract

Living with congenital heart disease (CHD) presents survivors with numerous stressors, which may contribute to emotional problems. This study examined (a) whether coping with CHD-related stress predicts symptoms of depression and anxiety, and (b) whether associations between coping and emotional distress are moderated by involuntary stress reactivity. Adolescents and young adults diagnosed with CHD ($M_{\text{age}} = 26.4$) were recruited from pediatric and adult outpatient cardiology clinics. Participants ($N = 168$) completed online self-report measures. Hierarchical multiple regression analyses revealed that secondary control coping (e.g., cognitive restructuring, positive thinking) predicted lower depression and anxiety. Primary control coping (e.g., problem-solving) and stress reactivity (e.g., rumination, emotional numbing) interacted to predict depression and anxiety: the higher individuals were in involuntary stress reactivity, the stronger was the association between primary control coping and lower depression and anxiety. These results can inform clinical efforts to prevent or reduce emotional distress among CHD survivors.

Keywords

Congenital heart disease; Coping; Stress responses; Depression; Anxiety

Introduction

Due to advancement in treatment for congenital heart disease (CHD), more than 90% of infants with CHD survive into adulthood (Moons, Bovijn, Budts, Belmans, & Gewillig, 2010). Consequently, there are over one million adults with CHD living in the United States (Gilboa et al., 2016). As CHD survivors transition through adolescence into adulthood, they may face a number of challenges due to their medical condition, such as on-going treatment,

Jennifer D. Monti Jennifer.Monti@nationwidechildrens.org.

Compliance with Ethical Standards

Conflict of interest Jennifer D. Monti, Jamie L. Jackson, and Kathryn Vannatta declare that they have no conflict of interest.

Human and Animal Rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed Consent Informed consent was obtained from all individual participants included in the study.

limitations at school or work, and worry about their future health. Because these stressors portend risk for emotional distress (Jackson, Gerardo, Daniels, & Vannatta, 2016; Kovacs et al., 2009; Kovacs & Utens, 2015), it is important to understand how individuals respond to CHD-specific stressors and the consequences of these responses for emotional functioning. Such knowledge is crucial to developing targeted interventions. Thus, the current study examined associations between responses to stress, including both active coping and involuntary stress reactivity, and symptoms of depression and anxiety in adolescent and young adult CHD survivors.

Stress and Emotional Functioning Among CHD Survivors

Living with CHD poses a range of challenges for survivors who may seek specialized care, manage treatments and medications, and encounter financial burden due to their healthcare needs. CHD survivors also may experience physical symptoms, lifestyle limitations, body image concerns, and reproductive or sexual dysfunction. Moreover, they may face uncertainty about their disease and future health (Jackson, Dulfer, & Utens, 2016; Jackson, Gerardo, et al., 2016; Kovacs, Sears, & Saidi, 2005; Warnes et al., 2008). Indeed, in a quantitative examination of CHD-related stress in the current sample, concerns about future health, scars and visible signs of medical procedures, and limitations in activities emerged, as some of the most difficult aspects of CHD, with 39–44% of survivors rating these stressors as somewhat or very stressful (Jackson, Gerardo, et al., 2016). Awareness of the stress associated with CHD has drawn research attention to the psychosocial functioning of survivors. A recent meta-analysis indicated that levels of emotional distress among CHD survivors are comparable to measure norms and study control groups, although some studies documented elevations in emotional distress (Jackson, Misiti, Bridge, Daniels, & Vannatta, 2015). Focusing exclusively on mean levels of adjustment may mask important variation in levels of distress experienced by individuals with CHD. For example, the current sample of CHD survivors did not differ from measure norms in terms of their mean level of internalizing symptoms, a broad psychopathological construct that includes symptoms of anxiety, depression, and withdrawal from social contacts (Achenbach & Rescorla, 2001). However, approximately 14% of CHD survivors reported internalizing symptoms in the clinical range, suggesting that a subset of survivors is at risk for significant emotional distress (Jackson, Gerardo, et al., 2016).

To improve prevention and intervention efforts for CHD survivors, it is important to identify factors that contribute to variability in emotional distress. Prior research on CHD has demonstrated that emotional distress in this population increases both with age (Jackson, Gerardo, et al., 2016; Karsdorp, Everaerd, Kindt, & Mulder, 2007) and heightened disease symptoms (Jackson, Gerardo, et al., 2016; Jackson, Hassen, Gerardo, Vannatta, & Daniels, 2016). Jackson et al. (2016) further noted that greater perceived CHD-related stress also predicts more internalizing symptoms. Building on this research, we anticipated that *responses* to CHD stress may be associated with emotional distress.

Responses to Stress

To conceptualize responses to stress, we drew from a well-validated framework (Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001; Connor-Smith, Compas,

Wadsworth, Thomsen, & Saltzman, 2000) that differentiates coping responses from involuntary forms of stress reactivity. Two forms of coping involve engagement responses directed toward the stressor or stress-related emotions. *Primary control coping* involves problem-solving, support seeking, and emotional expression, whereas *secondary control coping* involves cognitive restructuring, positive thinking, and acceptance. In contrast, *disengagement coping* involves voluntary efforts to avoid stress or stress-related emotions, such as behavioral avoidance or wishful thinking.

In comparison to the above forms of coping, stress reactivity includes involuntary reactions to stress. *Involuntary engagement* responses are characterized by intrusive or unregulated thoughts and emotions, such as rumination, physiological arousal, or emotional arousal. *Involuntary disengagement* responses involve uncontrolled withdrawal from stress, such as emotional numbing, cognitive withdrawal, and unregulated escape behaviors. Involuntary engagement and involuntary disengagement have been conceptualized as stress reactivity because they are non-deliberate or uncontrolled reactions to stress that occur in addition to voluntary efforts to cope with stressors. Individual differences in involuntary stress reactivity are posited to be temperamentally based and reflective of conditioned reactions to stress (Connor-Smith et al., 2000; Compas et al., 2001). Involuntary reactions to stress involve somatic responses (e.g., experiencing headaches when dealing with stress), affective responses (e.g., feeling no emotions), cognitive responses (e.g., rumination, or mind “going blank”), and behavioral (e.g., acting without thinking, freezing). These reactions to stress are distinct from psychopathology symptoms, but may confer risk for the development of psychopathology, including depression and anxiety (Compas, Connor-Smith, & Jaser, 2010).

Primary control coping and secondary control coping are broadly considered adaptive responses. In contrast, voluntary disengagement coping, involuntary engagement, and involuntary disengagement are considered maladaptive responses (Connor-Smith et al., 2000). Indeed, prior research on coping with chronic illnesses such as cancer or chronic pain indicates that primary control coping and secondary control coping are associated with emotional well-being, as indicated by lower levels of internalizing symptoms. In comparison, voluntary disengagement coping is associated with more emotional distress, as indicated by higher levels of internalizing symptoms (Compas, Beckjord, et al., 2006; Compas, Boyer, et al., 2006; Compas et al., 2014). Fewer studies have examined involuntary stress reactivity in the context of chronic illness, but research suggests that both involuntary engagement and involuntary disengagement are associated with more internalizing symptoms (Compas, Beckjord et al., 2006; Thomsen et al., 2002).

Among CHD survivors specifically, associations between coping and psychosocial outcomes have been examined in two recent studies, both of which used measures of general coping, not context-specific coping, and did not examine stress reactivity. Lee, Kim, and Young Choi (2014) reported that, among adolescent CHD survivors, greater use of task-oriented coping and avoidance-oriented coping was associated with better psychosocial functioning including: stronger feelings of personal competence, and acceptance of self and life. Although these results suggest that coping is related to well-being, it is not clear if coping predicts specific indicators of emotional distress, such as symptoms of depression and anxiety. Another study examined associations of coping with depression and anxiety among

adult CHD survivors (Eslami, Macassa, Sundin, Khankeh, & Soares, 2014). Consistent with research on coping with other chronic illnesses (Compas, Jaser, Dunn, & Rodriguez, 2012), greater use of active problem-solving was associated with lower levels of depression. However, for anxiety, greater use of active problem-solving and social support seeking was associated with higher levels of symptoms. This result was counter to prior research (Compas et al., 2012) that primarily assessed coping with illness-related stress.

To extend understanding of the associations between coping and symptoms of depression and anxiety among CHD survivors, the current study examined coping in response to CHD-related stressors. Based on prior theory and research, we believed that individuals' responses to stress and the effects of those responses may depend on the nature and context of the stressor (e.g., Connor-Smith et al., 2000). With respect to depression, we anticipated that primary control coping and secondary control coping would predict lower levels of depression, whereas voluntary disengagement coping would predict higher levels of depression. However, our investigation of the association between coping and anxiety was exploratory, given that prior research on CHD (Eslami et al., 2014) revealed associations between coping and anxiety that contrasted research on other chronic illnesses (Compas et al., 2012).

To extend prior research, we also considered that the effects of coping on emotional functioning may depend on the extent of involuntary engagement or involuntary disengagement. Broader studies on interpersonal and poverty-related stress provide evidence that coping and involuntary stress reactivity have interactive effects on well-being (Connor-Smith & Compas, 2004; Thompson et al., 2010; Wadsworth & Berger, 2006). In addition, emotion dysregulation and intense emotional arousal, which overlap with our concept of involuntary stress reactivity, have been posited as factors that may impede the effective implementation of coping efforts in psychotherapy (Nezu, Nezu, & D'Zurilla, 2013). However, research examining whether involuntary stress reactivity moderates the effects of coping is scarce. Information about such interaction effects can clarify whether particular coping strategies are universally beneficial or only beneficial for some individuals, which may be informative for clinical interventions.

We considered two potential ways in which involuntary stress reactivity could influence the effects of coping. First, the beneficial effects of primary control coping and secondary control coping may be *mitigated* by high involuntary stress reactivity. Specifically, when individuals experience intrusive thoughts and emotions (involuntary engagement) or uncontrolled withdrawal from stress (involuntary disengagement), these reactions may interfere with the effective use of strategies such as problem-solving (primary control coping), and strategies such as positive thinking and reframing (secondary control coping). Alternatively, the effects of coping may be *amplified* by high involuntary stress reactivity. Individuals who are high in involuntary stress reactivity may be prone to distress following stress exposure and in need of coping strategies that help them to manage or adapt to stress. Consequently, primary control coping and secondary control coping may be especially beneficial, and voluntary disengagement coping may be especially detrimental. Given the lack of prior research on such interactive effects, we explored whether involuntary stress reactivity moderates associations between coping and emotional functioning.

Study Overview

The current study sought to (1) examine the independent associations between coping with CHD-specific stressors and symptoms of depression and anxiety, and (2) to explore whether involuntary stress reactivity moderates associations between coping and emotional distress. The aims were examined in a sample of adolescent and young adult CHD survivors. Because this study sought to understand coping with the full range of stressors associated with CHD, the sample was heterogeneous in regard to disease severity and treatment history. Analyses took into account each individual's age and functional status since these variables have been previously documented to predict emotional functioning among CHD survivors.

Methods

Participants and Procedures

Adolescents and young adults diagnosed with CHD were recruited for a larger study from outpatient cardiology clinics at a pediatric hospital and an adult hospital in the Midwest. The larger study was a correlational, survey study of CHD knowledge, health behaviors, and psychosocial adjustment. Individuals were eligible for the study if they (a) had been diagnosed with a structural congenital heart defect; (b) were 15–39 years old; (c) were able to read and write in English; and (d) had not been diagnosed with a genetic syndrome (e.g., Down or Marfan's) that would prevent completion of self-report measures. Participants who met eligibility criteria were sent a letter from their attending cardiologist notifying them of a research opportunity. An opt-out number was provided in case patients did not want to be contacted about the study; however, none took this action. Approximately 1 week later, patients were contacted by study staff via phone or approached during an outpatient clinic visit if unable to be reached by phone. Consent/assent, as well as HIPPA authorization, was obtained. The study protocol and informed consent/assent procedures were approved by the Institutional Review Board. Of the 271 individuals invited to participate in this research, 10 declined, 51 could not be reached, and 210 (74%) provided informed consent and participated in the larger study. Participants completed online self-report measures, and demographic and medical information was extracted from medical charts. A measure of emotional functioning was added to the study protocol after recruitment began. Missing data for some of the variables used in the current analyses resulted in a final analytic sample of 168 participants (80%). Prior publications based on this dataset have not examined coping or stress reactivity. One prior report examined sources of CHD-related stress and general internalizing symptoms, drawing data from the same measures reported here (Jackson, Gerardo, et al., 2016).

Measures

Symptoms of Depression and Anxiety—Thirty-four adolescents (15–18 years) completed the Youth Self-Report (YSR; Achenbach & Rescorla, 2001), and 134 young adults (19 years and older) completed the Adult Self-Report (ASR; Achenbach & Rescorla, 2003). Symptoms of depression were indicated by the DSM-oriented affective problems subscale of YSR (13 items) and the depressive problems subscale of the ASR (14 items), both of which assess symptoms of dysthymia and major depressive disorder. These subscales share common items, but vary slightly for the purpose of assessing age-appropriate

presentation of symptoms. Symptoms of anxiety were indicated by the DSM-oriented anxiety problems subscales of the YSR (6 items) and ASR (7 items), both of which assess symptoms of generalized anxiety, separation anxiety, and specific phobia. These subscales share common items, but vary slightly for the purpose of assessing age-appropriate presentation of symptoms. The YSR and ASR are structured in the same format. Participants were instructed to read a list of items and rate how true each item was for them over the past 6 months. Typical items on the affective problems and depressive problems subscales are “I cry a lot” and “There is very little that I enjoy.” Typical items on the anxiety problems subscales are “I worry a lot” and “I am too fearful or anxious.” Response scales ranged from 0 = *not true* to 2 = *very true or often true* and responses were summed to create subscale scores. To capture the full range of variability in depression and anxiety, raw scores were used (Achenbach & Rescorla, 2001, 2003). Because the structure and content of the YSR affective problems subscale and the ASR depressive problems subscale are parallel, they were treated as a single measure of depressive symptoms. Similarly, the YSR and ASR anxiety problems subscales were treated as a single measure of anxiety. Because the number of items on the YSR and ASR subscales differs, YSR scores were prorated to produce comparable raw scores. For symptoms of depression and symptoms of anxiety, the ASR subscale had one more item than the YSR subscale. Thus, the total YSR score was divided by the number of YSR items and multiplied by the number of ASR items. Possible scores for symptoms of depression ranged from 0 to 28 and possible scores for symptoms of anxiety ranged from 0 to 14, with higher scores reflecting greater emotional distress. The reliability and validity of the YSR and ASR have been established (Achenbach & Rescorla, 2001, 2003). In the present sample, Cronbach alphas for the measures of depression symptoms were .74 for the YSR and .85 for the ASR. For measures of anxiety symptoms, the corresponding alphas were .79 for the YSR and .81 for the ASR.

Responses to Stress—Participants completed a version of the Responses to Stress Questionnaire (Connor-Smith et al., 2000) adapted to include sources of stress related to CHD (Jackson, Gerardo, et al., 2016). The measure (57 items) includes three coping subscales: Primary Control Coping (9 items), Secondary Control Coping (12 items), and voluntary Disengagement Coping (9 items). The measure also includes two stress reactivity (i.e., involuntary stress response) subscales: Involuntary Engagement (15 items) and Involuntary Disengagement (12 items). Participants were prompted to think about CHD-specific stressors (e.g., taking medications, paying for healthcare) and instructed to rate how often they did or felt each response when dealing with the stress of having CHD. Typical Primary Control Coping items are “I do something to try to fix the stressful parts of having CHD” and “I do something to calm myself down when I’m dealing with the stress of having CHD.” Typical Secondary Control Coping items are “I think about the things I’m learning from having CHD, or something good that will come from it” and “I tell myself that everything will be all right.” Typical voluntary Disengagement Coping items are “I try to believe that it never happened” and “I try not to think about it, to forget all about it.” Typical Involuntary Engagement items are “My thoughts start racing when I am faced with the stressful parts of having CHD” and “When I am dealing with the stress of having CHD, I feel it in my body.” Typical Involuntary Disengagement items are “My mind just goes blank when the stressful parts of having CHD happen; I can’t think at all” and “I just freeze when I

am dealing with stressful parts of having CHD; I can't do anything." Response scales ranged from: 1 = *Not at all* to 4 = *A lot*. In accordance with the standard scoring of the RSQ (Compas et al., 2001), proportion scores were computed by dividing the total score for each subscale by the total score on the measure. Thus, proportion scores for each subscale were bounded by 0 and 1, with higher scores reflecting higher levels of each response to stress. The reliability and validity of the subscales have been established (Connor-Smith et al., 2000). In the present sample, Cronbach alphas for the five RSQ subscales ranged from .76 to .95, as shown in the last column of Table 2.

Covariates—Sex, age, and functional status were determined based on medical chart review. Functional status was indicated by New York Heart Association (NYHA) class (American Heart Association, 2016), which is determined by the physician based on patient-reported symptom burden and ranges from I (no limitation of physical activity) to IV (unable to carry on any physical activity without discomfort). A recent study found that having a NYHA class of II or greater (vs. a NYHA class of I) was associated with significantly lower emotional quality of life, and explained more variability in emotional quality of life than the traditional classification system of CHD severity (i.e., "simple," "moderate," and "complex"; Jackson, Hassen, et al., 2016). Accordingly, the current study classified participants into two groups: normal functioning (NYHA = I; no limitation on physical activity; 71.4% of participants) and impaired functioning (NYHA = II, III, or IV; mild to severe limitations on physical activity; 28.6% of participants).

Plan of Analysis

Independent *t* tests examined sex differences in depression and anxiety, and bivariate correlations between study variables were examined. Potential covariates (i.e., gender, age, functional status) that were significantly associated with depression or anxiety were retained in subsequent multivariate analyses. Hierarchical regression analyses were conducted predicting symptoms of depression and symptoms of anxiety. Age and functional status (1 = normal functioning; 2 = impaired functioning) were entered as covariates in the first step, and the three forms of coping (i.e., Primary Control Coping, Secondary Control Coping, and voluntary Disengagement Coping) were entered in the second step. The focal form of stress reactivity (i.e., Involuntary Engagement or Involuntary Disengagement) was entered in the third step. Interactions between each form of coping and stress reactivity were entered in the final step. Examination of two forms of emotional distress and two forms of stress reactivity yielded four regression models. Non-significant Coping $\times$ Stress Reactivity interactions were trimmed to create final models. The final models predicting symptoms of depression and anxiety are presented in Tables 4 and 5, respectively. Analyses were conducted in SPSS version 21 (IBM Corp., 2012). Predictors were standardized to facilitate interpretation of interaction effects. Significant interactions were probed by examining regions of significance using the Johnson-Neyman technique in the PROCESS macro (Hayes, 2013). Throughout the results, significance was defined as $p < .05$.

Results

Sample Characteristics

Table 1 presents demographic and medical status characteristics of the study participants. Participants were evenly distributed by gender and were predominantly Caucasian. Lesion severity, which is based on both the location and type of cardiac lesion and surgical intervention (Warnes et al., 2008), was representative of the outpatient clinics from which participants were recruited (28.6% simple; 41.7% moderate; 29.8% complex).

Descriptive Statistics and Intercorrelations

Table 2 presents descriptive statistics. Mean scores for symptoms of depression and anxiety fell in the normal range. However, compared to measure norms, a greater proportion of participants had scores falling in the borderline or clinical range (93rd percentile) for symptoms of depression (16%), $\chi^2(1) = 21.56, p = .00$, and anxiety (12%), $\chi^2(1) = 6.35, p = .01$. Symptoms of depression and anxiety did not significantly differ by sex (for depression, $t(166) = -.72, p = .47$; for anxiety, $t(166) = -1.96, p = .052$).

Table 3 presents the intercorrelations among the study variables. Higher levels of depression and anxiety were each associated with lower Primary Control Coping, lower Secondary Control Coping, higher voluntary Disengagement Coping, higher Involuntary Engagement and higher Involuntary Disengagement. Higher depression and anxiety were associated with impaired functional status. Higher anxiety was also associated with older age within the sample range (i.e., 15–39 years). Thus, functional status and age were retained as covariates in subsequent analyses.

Responses to Stress as Predictors of Symptoms of Depression and Anxiety

Symptoms of Depression—After adjusting for age and functional status, Primary Control Coping and Secondary Control Coping predicted lower levels of depression. In Model 1a examining Involuntary Engagement as a moderator of coping, no main effect of stress reactivity was found; however, the Primary Control Coping $\times$ Involuntary Engagement interaction was significant ($B = -.97, SE = .46, \beta = -.20, p = .04$). The Secondary Control Coping $\times$ Involuntary Engagement ($B = -.25, SE = .45, \beta = -.06, p = .57$) and Disengagement Coping $\times$ Involuntary Engagement ($B = -.29, SE = .45, \beta = -.06, p = .53$) interactions were non-significant and were removed from the model. Results from the final model are presented in Table 4. The Primary Control Coping $\times$ Involuntary Engagement interaction was probed by examining regions of significance. Results indicated that the negative association between Primary Control Coping and symptoms of depression became stronger as Involuntary Engagement responses increased. Primary Control Coping significantly predicted lower levels of depression only when Involuntary Engagement was approximately a quarter of a standard deviation below the mean (i.e., a standardized score of $-.29$) or higher.

In Model 1b examining Involuntary Disengagement as a moderator of coping, no main effect of stress reactivity was found; however, there was a significant Primary Control Coping $\times$ Involuntary Disengagement interaction ($B = -.95, SE = .45, \beta = -.20, p = .04$). The

Secondary Control Coping $\times$ Involuntary Disengagement ($B = -.15$, $SE = .46$, $\beta = -.03$, $p = .75$) and Disengagement Coping $\times$ Involuntary Disengagement ($B = .06$, $SE = .57$, $\beta = .01$, $p = .92$) interactions were non-significant and were removed from the model. Results from the final model are presented in Table 4. The Primary Control Coping $\times$ Involuntary Disengagement interaction was probed by examining regions of significance. Results indicated that the negative association between Primary Control Coping and symptoms of depression became stronger as Involuntary Disengagement responses increased. Primary Control Coping significantly predicted lower levels of depression only when Involuntary Disengagement was above average (i.e., exceeded a standardized score of .6).

Symptoms of Anxiety—After adjusting for age and functional status, Secondary Control Coping predicted lower levels of anxiety. In Model 2a examining Involuntary Engagement as a moderator of coping, no main effect of stress reactivity was found; however, the Primary Control Coping $\times$ Involuntary Engagement interaction was significant ($B = -.69$, $SE = .30$, $P = -.22$, $p = .02$). The Secondary Control Coping $\times$ Involuntary Engagement ($B = -.12$, $SE = .29$, $P = -.05$, $p = .69$), and Disengagement Coping $\times$ Involuntary Engagement ($B = -.45$, $SE = .29$, $P = -.14$, $p = .12$) interactions were non-significant and were removed from the model. Results from the final model are presented in Table 5. The Primary Control Coping $\times$ Involuntary Engagement interaction was probed by examining regions of significance. Results indicated that the negative association between Primary Control Coping and symptoms of anxiety became stronger as Involuntary Engagement responses increased. Primary Control Coping significantly predicted lower levels of anxiety only when Involuntary Engagement was approximately two standard deviations above the mean (i.e., a standardized score of 1.86) or higher.

In Model 2b examining Involuntary Disengagement as a moderator of coping, no main effect of stress reactivity was found; however, the Primary Control Coping $\times$ Involuntary Disengagement interaction was significant ($B = -.66$, $SE = .29$, $\beta = -.21$, $p = .03$). The Secondary Control Coping $\times$ Involuntary Disengagement ($B = -.08$, $SE = .30$, $\beta = -.02$, $p = .80$) and Disengagement Coping $\times$ Involuntary Disengagement ($B = -.45$, $SE = .37$, $\beta = -.12$, $p = .23$) interactions were non-significant and were removed from the model. Results from the final model are presented in Table 5. After removing these interactions, the Primary Control Coping $\times$ Involuntary Disengagement interaction was reduced to marginal significance ($p = .054$). Because interactions between Primary Control Coping and stress reactivity were evident in the other models, the interaction was probed by examining regions of significance. Results indicated that the negative association of Primary Control Coping and symptoms of anxiety became stronger as Involuntary Disengagement responses increased. Primary Control Coping significantly predicted lower levels of anxiety only when Involuntary Disengagement was slightly below the mean (i.e., a standardized score of $-.19$) or higher.

Discussion

In order to improve outcomes among CHD survivors, it is important to identify factors that predict variability in emotional distress in this population. In light of the many challenges inherent to living with CHD (Jackson, Gerardo, et al., 2016; Kovacs et al., 2009; Kovacs &

Utens, 2015), this study examined whether responses to CHD-related stress predict emotional distress among adolescent and young adult survivors. We investigated the unique associations of three forms of coping with symptoms of depression and anxiety, and explored whether these associations differ depending on involuntary stress reactivity. These aims were examined using theoretically based and psychometrically strong measures of responses to stress and emotional functioning in a sample of CHD survivors with a representative range in disease severity.

Individually, primary control coping and secondary control coping were associated with lower depression and anxiety, whereas voluntary disengagement coping was associated with higher depression and anxiety, consistent with prior research (Compas, Beckjord, et al., 2006; Compas, Boyer, et al., 2006). However, coping strategies are not utilized in isolation. When the three forms of coping were examined simultaneously as predictors of emotional distress, secondary control coping accounted for unique variance in symptoms of depression and anxiety. Secondary control coping involves adapting to stress through positive thinking, cognitive reappraisal, and acceptance. These strategies may help survivors to maintain positive affect and a sense of optimism, which in turn may reduce vulnerability to depression. These strategies also may minimize the degree to which CHD-related stressors are perceived as problematic or overwhelming, thereby reducing vulnerability to anxiety.

Involuntary engagement and involuntary disengagement were correlated with higher levels of depression and anxiety; however, these dimensions of involuntary stress reactivity did not independently account for unique variance in emotional distress. Instead, associations between primary control coping and emotional distress were conditional on involuntary engagement and involuntary disengagement responses, such that the more reactive individuals were to stress, the *stronger* was the association between primary control coping and lower emotional distress. Primary control coping strategies address the source of stress or stress-related emotions through problem-solving and emotional expression or regulation. Individuals who experience involuntary stress reactivity may be in greater need of these strategies, and therefore benefit to a greater extent.

The unique association between secondary control coping and internalizing symptoms parallels research on child and adolescent coping with cancer-related stress using the same conceptual framework and measures (Compas et al., 2014). Both CHD and cancer present individuals with uncontrollable stressors (e.g., lifestyle limitations in the case of CHD; treatment side effects in the case of cancer), which may be well suited for coping strategies aimed at adapting to stress (Compas et al., 2001). Taken together, these results support the notion that secondary control coping is an effective response to chronic illnesses involving a large degree of uncontrollable stress.

In the current study, primary control coping was correlated with lower levels of depression and anxiety. When other responses to stress were taken into account, primary control coping predicted lower emotional distress among survivors who experienced moderate to high levels of stress reactivity. These results depart from one investigation of coping among CHD survivors, which found that active problem-focused coping and social support seeking, which overlap with primary control coping, were associated with lower depression but

higher anxiety (Eslami et al., 2014). It is not clear why discrepant associations between primary control coping and anxiety emerged in the present study as compared to the study by Eslami et al. (2014). However, the association between primary control coping and lower anxiety is consistent with prior research on coping with other health-related stressors (Compas, Beckjord, et al., 2006; Thomsen et al., 2002).

The current study extends existing research on coping among CHD survivors and on responses to illness-related stress more broadly. To our knowledge, only two prior studies have examined associations between coping and psychosocial outcomes among CHD survivors (Eslami et al., 2014; Lee et al., 2014). Extending this research, the current study examined associations between coping with CHD-specific stressors and emotional distress, and explored if these associations depend on stress reactivity. Within the larger body of research on coping with chronic illness, little attention has been given to the role of stress reactivity in emotional functioning. The present results suggest that involuntary stress reactivity is associated with emotional distress, and the effects of primary control coping efforts on emotional functioning may be heightened when individuals experience these reactions to illness-related stress. Thus, research in other populations may benefit from considering the implications of involuntary stress reactivity for psychosocial outcomes.

The results of the current study also suggest that applied efforts to promote effective coping may need to take involuntary stress reactivity into account, as the benefits of some coping strategies may depend on the extent to which individuals experience involuntary stress reactivity. This notion intersects with the conceptual model underlying problem-solving therapy (Nezu, 2004), which posits that a negative problem orientation (e.g., beliefs that problems are unsolvable, appraisals of problems as threatening, and negative emotional responses) may hinder attempts at problem-solving. The results of the current study may seem inconsistent with the problem-solving model. However, a negative problem orientation may be distinct from involuntary stress reactions, such as rumination or emotional and behavioral withdrawal. A negative problem orientation may hinder effective problem-solving, whereas involuntary stress reactivity may reflect a vulnerability that leads individuals to benefit from problem-solving and other primary control coping strategies (e.g., emotion regulation).

Several limitations of this research warrant consideration. The concurrent nature of this study precludes conclusions about causal associations between responses to stress and emotional functioning. Longitudinal studies examining the prospective effects of responses to stress on changes in emotional functioning are needed to identify the direction of effect. This design also leaves open the possibility that confounding variables account for the results. Although we took several covariates (i.e., age and symptom severity) into account, other factors, such as perceptions of stress, could contribute both to responses to stress and emotional distress. In addition, this study is limited by reliance on single-informant data and self-report questionnaires. Self-reports are advantageous in that they provide insight into aspects of involuntary stress reactivity and emotional distress that may be otherwise unobservable. However, to reduce shared method variance, future research may benefit from incorporating multiple informants or multiple methods, such as direct measures of physiological stress responses or diagnostic interviews assessing emotional distress. Finally,

like many prior studies on CHD, the results of this study are based on a largely Caucasian sample. Additional research is needed to determine the generalizability of these results and, more broadly, to develop a better understanding of psychosocial functioning among racial minorities living with CHD.

To extend the current research, it will be important to examine if coping and involuntary stress reactivity have similar associations with emotional functioning among younger samples of CHD survivors. In addition, it would be interesting to explore what factors contribute to the development of coping and stress reactivity among CHD survivors. For example, parents may encourage or model particular coping behaviors or stress responses, as in other contexts of childhood stress (Abaied & Rudolph, 2011; Monti, Abaied, & Rudolph, 2014). Identifying early antecedents of survivors' responses to stress could be informative for applied efforts to prevent the development of maladaptive stress responses and emotional distress in this population from an early age.

It may also be interesting for future work to consider the relevance of pediatric medical traumatic stress models (Kazak et al., 2006) to the current results. Post traumatic stress symptoms may have some overlap with involuntary stress reactivity and symptoms of anxiety, though individual differences in involuntary stress reactivity are expected to be independent of trauma history. It will be important for such investigations to determine if CHD survivors are at greater risk for post-traumatic stress symptoms than individuals without a medical history, and to establish whether CHD survivors experience their symptoms or treatment as traumatic.

In sum, the results of this study indicate that greater use of secondary control coping is associated with lower levels of depression and anxiety among CHD survivors. Primary control coping is also associated with lower depression and anxiety among survivors who experience moderate to high levels of stress reactivity. These results can inform applied efforts to promote emotional well-being in this population. It may be helpful to teach CHD survivors secondary control coping skills, such as how to use cognitive reappraisal, positive thinking, and acceptance in response to CHD-related stress. Prior research has demonstrated that secondary control coping can be successfully targeted through cognitive-behavioral programs (Compas, Champion, et al., 2010; Compas, et al., 2010), suggesting that this form of coping is amenable to intervention.

The results of this study also suggest that teaching primary control coping skills (e.g., problem-solving, emotion regulation, and expression) may particularly benefit CHD survivors who experience strong involuntary stress responses, such as rumination, physiological arousal, emotional numbing, or cognitive withdrawal. It is promising that survivors who may be particularly vulnerable to stress appear to benefit the most from primary control coping strategies. Implementation of primary control coping strategies (e.g., emotional regulation) may directly alleviate symptoms of involuntary stress reactivity (e.g., emotional arousal), or may help individuals to manage stress effectively in spite of their reactivity. Future research is needed to determine if primary control coping can be targeted through existing clinical approaches. Notably, problem-solving therapy (D'Zurilla & Nezu, 2009; Nezu, Nezu, Friedman, Faddis, & Houts, 1998) aims to promote problem-solving

behaviors (e.g., emotion regulation, planful problem-solving), as well as to address problem-orientation (e.g., self-efficacy, emotional responses to problems; Nezu et al., 2013). Developing effective coping skills among CHD survivors may serve as an important mechanism for improving emotional adjustment.

Acknowledgements

This research was supported by National Institutes of Health grant T32 HL-098039 (to J.L. Jackson), The Heart Center at Nationwide Children's Hospital (C. Daniels and K. Vannatta), and the Clinical and Translational Science Award grant UL1TR001070 at The Ohio State University and Nationwide Children's Hospital.

References

- Abaied JL, & Rudolph KD (2011). Maternal influences on youth responses to peer stress. *Developmental Psychology*, 47, 1776–1785. 10.1037/a0025439. [PubMed: 21910532]
- Achenbach TM, & Rescorla LA (2001). *Manual for the ASEBA school-age forms & profiles*. Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families.
- Achenbach TM, & Rescorla LA (2003). *Manual for the ASEBA adult forms & profiles*. Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families.
- American Heart Association. (2016). Classes of heart failure. Retrieved from http://www.heart.org/HEARTORG/Conditions/HeartFailure/AboutHeartFailure/Classes-of-Heart-Failure_UCM_306328_Article.jsp#.V1GFs-TpKiw.
- Compas BE, Beckjord E, Agocha B, Sherman ML, Langrock A, Grossman CI, ... Luecken L (2006). Measurement of coping and stress responses in women with breast cancer. *Psychooncology*, 15, 1038–1054. 10.1002/pon.999. [PubMed: 17009343]
- Compas BE, Boyer MC, Stanger C, Colletti RB, Thomsen AH, Dufton LM, & Cole DA (2006). Latent variable analysis of coping, anxiety/depression, and somatic symptoms in adolescents with chronic pain. *Journal of Consulting and Clinical Psychology*, 74, 1132–1142. 10.1037/0022-006X.74.6.1132. [PubMed: 17154742]
- Compas BE, Champion JE, Forehand R, Cole DA, Reeslund KL, Fear J, ... Roberts L (2010). Coping and parenting: Mediators of 12-month outcomes of a family group cognitive-behavioral preventive intervention with families of depressed parents. *Journal of Consulting and Clinical Psychology*, 78, 623–634. 10.1037/a0020459. [PubMed: 20873898]
- Compas BE, Connor-Smith JK, & Jaser SS (2010). Temperament, stress reactivity, and coping: implications for depression in childhood and adolescence. *Journal of Clinical Child & Adolescent Psychology*, 33, 21–31.
- Compas BE, Connor-Smith JK, Saltzman H, Thomsen AH, & Wadsworth ME (2001). Coping with stress during childhood and adolescence: Problems, progress, and potential in theory and research. *Psychological Bulletin*, 127, 87–127. [PubMed: 11271757]
- Compas BE, Desjardins L, Vannatta K, Young-Saleme T, Rodriguez EM, Dunn M, ... Gerhardt CA (2014). Children and adolescents coping with cancer: Self-and parent reports of coping and anxiety/depression. *Health Psychology*, 33, 853–861. 10.1037/hea0000083. [PubMed: 25068455]
- Compas BE, Jaser SS, Dunn MJ, & Rodriguez EM (2012). Coping with chronic illness in childhood and adolescence. *Annual Review of Clinical Psychology*, 8, 455–480. 10.1146/annurev-clinpsy-032511-143108.
- Connor-Smith JK, & Compas BE (2004). Coping as a moderator of relations between reactivity to interpersonal stress, health status, and internalizing problems. *Cognitive Therapy and Research*, 28, 347–368. 10.1023/B:COTR.0000031806.25021.d5.
- Connor-Smith JK, Compas BE, Wadsworth ME, Thomsen AH, & Saltzman H (2000). Responses to stress in adolescence: Measurement of coping and involuntary stress responses. *Journal of Consulting and Clinical Psychology*, 68, 976–992. 10.1037//0022-006X.68.6.976. [PubMed: 11142550]
- D'Zurilla TJ, & Nezu AM (2009). Problem-solving therapy In Dobson KS (Ed.), *Handbook of cognitive-behavioral therapies* (3rd ed.). New York, NY: Guilford Press.

- Eslami B, Macassa G, Sundin O, Khankeh HR, & Soares JJ (2014). Style of coping and its determinants in adults with congenital heart disease in a developing country. *Congenital Heart Disease*, 9, 349–360. 10.1111/chd.12150. [PubMed: 25247217]
- Gilboa SM, Devine OJ, Kucik JE, Oster ME, Riehle-Cola-russo T, Nembhard WN, ... Marelli AJ(2016). Congenital heart defects in the United States: Estimating the magnitude of the affected population in 2010. *Circulation*, 134, 101–109. 10.1161/circulationaha.115.019307. [PubMed: 27382105]
- Hayes AF (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford Press.
- IBM Corp. (2012). *IBM SPSS Statistics for Windows, Version 21.0*. Armond, NY: IBM Corp.
- Jackson JL, Dulfer K, & Utens EM (2016). Adolescent behavior In Schwerzmann M, Thomet C & Moons P (Eds.), *Congenital heart disease and adolescence* (pp. 181–190). Switzerland: Springer.
- Jackson JL, Gerardo GM, Daniels CJ, & Vannatta K (2016). Perceptions of disease-related stress: A key to better understanding patient-reported outcomes among survivors of congenital heart disease. *Journal of Cardiovascular Nursing*. 10.1097/jcn.0000000000000371.
- Jackson JL, Hassen L, Gerardo GM, Vannatta K, & Daniels CJ (2016). Medical factors that predict quality of life for young adults with congenital heart disease: What matters most? *International Journal of Cardiology*, 202, 804–809. 10.1016/j.ijcard.2015.09.116. [PubMed: 26476036]
- Jackson JL, Misiti B, Bridge JA, Daniels CJ, & Vannatta K (2015). Emotional functioning of adolescents and adults with congenital heart disease: A meta-analysis. *Congenital Heart Disease*, 10, 2–12. 10.1111/chd.12178. [PubMed: 24612910]
- Karsdorp PA, Everaerd W, Kindt M, & Mulder BJ (2007). Psychological and cognitive functioning in children and adolescents with congenital heart disease: A meta-analysis. *Journal of Pediatric Psychology*, 32, 527–541. 10.1093/jpepsy/jsl047. [PubMed: 17182669]
- Kazak AE, Kassam-Adams N, Schneider S, Zelikovsky N, Alderfer MA, & Rourke M (2006). An integrative model of pediatric medical traumatic stress. *Journal of Pediatric Psychology*, 31, 343–355. [PubMed: 16093522]
- Kovacs AH, Saidi AS, Kuhl EA, Sears SF, Silversides C, Harrison JL, ... Nolan RP. (2009). Depression and anxiety in adult congenital heart disease: Predictors and prevalence. *International Journal of Cardiology*, 137, 158–164. 10.1016/j.ijcard.2008.06.042. [PubMed: 18707776]
- Kovacs AH, Sears SF, & Saidi AS (2005). Biopsychosocial experiences of adults with congenital heart disease: Review of the literature. *American Heart Journal*, 150, 193–201. 10.1016/j.ahj.2004.08.025. [PubMed: 16086917]
- Kovacs AH, & Utens EM (2015). More than just the heart: Transition and psychosocial issues in adult congenital heart disease. *Cardiology Clinics*, 33, 625–634. 10.1016/j.ccl.2015.07.005. [PubMed: 26471825]
- Lee S, Kim S, & Choi JY (2014). Coping and resilience of adolescents with congenital heart disease. *Journal of Cardiovascular Nursing*, 29, 340–346. 10.1097/JCN.0b013e3182865367. [PubMed: 23416944]
- Monti JD, Abaied JL, & Rudolph KD (2014). Contributions of socialisation of coping to physiological responses to stress. *Australian Journal of Psychology*, 66, 102–109. 10.1111/ajpy.12044. [PubMed: 26973351]
- Moons P, Bovijn L, Budts W, Belmans A, & Gewillig M (2010). Temporal trends in survival to adulthood among patients born with congenital heart disease from 1970 to 1992 in Belgium. *Circulation*, 122, 2264–2272. 10.1161/circulationaha.110.946343. [PubMed: 21098444]
- Nezu AM (2004). Problem solving and behavior therapy revisited. *Behavior Therapy*, 35, 1–33. 10.1016/s0005-7894(04)80002-9.
- Nezu AM, Nezu CM, & D’Zurilla T (2013). *Problem-solving therapy: A treatment manual*. New York, NY: Springer.
- Nezu AM, Nezu CM, Friedman SH, Faddis S, & Houts PS (1998). *Helping cancer patients cope: A problem solving approach*. Washington, DC: American Psychological Association.
- Thompson RJ, Mata J, Jaeggi SM, Buschkuhl M, Jonides J, & Gotlib IH (2010). Maladaptive coping, adaptive coping, and depressive symptoms: Variations across age and depressive state. *Behaviour Research and Therapy*, 48, 459–466. 10.1016/j.brat.2010.01.007. [PubMed: 20211463]

- Thomsen AH, Compas BE, Colletti RB, Stanger C, Boyer MC, & Konik BS (2002). Parent reports of coping and stress responses in children with recurrent abdominal pain. *Journal of Pediatric Psychology*, 27, 215–226. [PubMed: 11909929]
- Wadsworth ME, & Berger LE (2006). Adolescents coping with poverty-related family stress: Prospective predictors of coping and psychological symptoms. *Journal of Youth and Adolescence*, 35, 57–70. 10.1007/s10964-005-9022-5.
- Warnes CA, Williams RG, Bashore TM, Child JS, Connolly HM, Dearani JA, . Webb GD. (2008). ACC/AHA 2008 guidelines for the management of adults with congenital heart disease: Executive summary. *Journal of the American College of Cardiology*, 52, 2395–2451. 10.1016/j.jacc.2008.10.001.

Table 1

Sample characteristics

Variables	<i>M (SD) or %</i>
Age (in years)	26.42 (7.26)
Gender (% female)	56.5%
Race (% Caucasian)	88.7%
Education (% completed or current)	
High school	57.1%
Post-high school/trade school	7.1%
College	2.0%
Graduate/professional school	10.7%
NYHA functional class	
I	71.4%
II, III, IV	28.6%
History of cardiac surgery (% received surgery)	77.4%
Number of hospitalizations within past two years	.33 (.98)

NYHA functional class I = normal functioning (no limitation on physical activity); NYHA functional class II, III, or IV = impaired functioning (mild to severe limitations on physical activity)

Table 2Descriptive statistics ($N = 167-168$)

Variables	<i>M</i>	<i>SD</i>	Range	α
Symptoms of depression	5.56 ^a	4.91 ^a	0–28 ^a	.74/.85 ^b
Symptoms of anxiety	4.21 ^a	3.27 ^a	0–14 ^a	.79/.81 ^b
Primary Control Coping	.18	.04	.09–.26	.76
Secondary Control Coping	.30	.06	.10–.44	.83
Disengagement Coping	.14	.03	.09–.23	.84
Involuntary Engagement	.22	.05	.15–.39	.95
Involuntary Disengagement	.16	.03	.11–.25	.91

Symptoms of depression and anxiety are raw scores from the DSM-oriented scales of the Youth/Adult Self-Report. Responses to stress scores are proportion scores from the Responses to Stress Questionnaire.

^a Descriptive statistics across the Youth and Adult Self-Report

^b α for Youth Self-Report/Adult Self-Report

Table 3Correlations between emotional functioning, responses to stress, and covariates ($N = 167-168$)

Variables	1	2	3	4	5	6	7	8
1. Symptoms of depression	–							
2. Symptoms of anxiety	.72***	–						
3. Primary Control Coping	–.23**	–.18*	–					
4. Secondary Control Coping	–.29***	–.32***	.33***	–				
5. Disengagement Coping	.17*	.16*	–.57***	–.51***	–			
6. Involuntary Engagement	.28***	.35***	–.46***	–.85***	.28***	–		
7. Involuntary Disengagement	.28***	.21**	–.61***	–.72***	.42***	.54***	–	
8. Age	.05	.22**	–.02	–.07	.03	.11	–.02	–
9. Functional status ^a	.19*	.19*	–.04	–.16*	.12	.18*	–.01	.16*

^aFunctional status: 1 = normal functioning (NYHA class I; no limitation on physical activity), 2 = impaired functioning (NYHA class II, III, or IV; mild to severe limitations on physical activity)* $p < .05$ ** $p < .01$ *** $p < .001$

Table 4

Hierarchical regression models predicting symptoms of depression as a function of coping and stress reactivity ($N = 167$)

Predictor variable	Model 1a					Model 1b				
	<i>B</i>	<i>SE B</i>	β	<i>p</i>	<i>R</i> ²	<i>B</i>	<i>SE B</i>	β	<i>p</i>	<i>R</i> ²
Step 1: covariates					.05					.05
Age	.03	.05	.04	.62		.03	.05	.04	.62	
Functional status ^a	2.32	.85	.21	.01		2.32	.85	.21	.01	
Step 2: Coping					.11					.11
Primary Control Coping	-.94	.44	-.19	.04		-.94	.44	-.19	.04	
Secondary Control Coping	-1.37	.43	-.27	.00		-1.37	.43	-.27	.00	
Disengagement Coping	-.38	.53	-.07	.47		-.38	.53	-.07	.47	
Step 3: Stress Reactivity					.00					.00
Involuntary engagement	-.71	.96	-.14	.46		—	—	—	—	
Involuntary disengagement	—	—	—	—		.58	.67	.12	.39	
Step 4: Moderation by stress reactivity					.04					.04
Primary Control Coping $\times$ Involuntary Engagement	-.96	.36	-.20	.01		—	—	—	—	
Primary Control Coping $\times$ Involuntary Disengagement	—	—	—	—		-1.04	.36	-.22	.00	

Model 1a examines whether the effect of coping is moderated by Involuntary Engagement. Model 1b examines whether the effect of coping is moderated by Involuntary Disengagement. *B* = unstandardized regression coefficient. *p* = standardized regression coefficient

^aFunctional status: 1 = normal functioning (NYHA class I; no limitation on physical activity), 2 = impaired functioning (NYHA class II, III, or IV; mild to severe symptom limitations on physical activity)

Table 5

Hierarchical regression models predicting symptoms of anxiety as a function of coping and stress reactivity ($N = 167$)

Predictor variable	Model 2a					Model 2b				
	<i>B</i>	<i>SE B</i>	β	<i>p</i>	<i>R</i> ²	<i>B</i>	<i>SE B</i>	β	<i>p</i>	<i>R</i> ²
Step 1: Covariates					.07					.07
Age	.09	.03	.19	.01		.09	.03	.19	.01	
Functional status ^a	1.18	.55	.16	.03		1.18	.55	.16	.03	
Step 2: Coping					.09					.09
Primary Control Coping	-.41	.29	-.13	.15		-.41	.29	-.13	.15	
Secondary Control Coping	-.96	.28	-.29	.00		-.96	.28	-.29	.00	
Disengagement Coping	-.31	.34	-.09	.36		-.31	.34	-.09	.36	
Step 3: Stress reactivity					.01					.01
Involuntary engagement	.61	.62	.19	.33		—	—	—	—	
Involuntary disengagement	—	—	—	—		-.40	.43	-.12	.37	
Step 4: Coping $\times$ Stress Reactivity					.02					.02
Primary Control Coping $\times$ Involuntary Engagement	-.51	.24	-.16	.03		—	—	—	—	
Primary Control Coping $\times$ Involuntary Disengagement	—	—	—	—		-.47	.24	-.15	.05	

Model 2a examines whether the effect of coping is moderated by Involuntary Engagement. Model 2b examines whether the effect of coping is moderated by Involuntary Disengagement. *B* = unstandardized regression coefficient. β = standardized regression coefficient

^aFunctional Status: 1 = normal functioning (NYHA class I; no limitation on physical activity), 2 = impaired functioning (NYHA class II, III, or IV; mild to severe limitations on physical activity)