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Psychological aspects and hospitalization for pain crises in youth with sickle-cell disease

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Abstract

Sickle-cell disease is a genetic disorder characterized by severe pain episodes or “vaso-occlusive crises” that may require hospitalization. This study examined the associations among emotion regulation, somatization, positive and negative affect, and hospitalizations for pain crises in youth with sickle-cell disease. Multivariate analyses indicated that emotional suppression and somatization were significantly associated with more frequent hospitalizations for pain crises in the previous year after controlling for sickle-cell disease type and pain. These results suggest that efforts to reduce emotional suppression and somatization may assist in decreasing the frequency of hospitalizations for pain crises among youth with sickle-cell disease.

Keywords

adolescence; children; emotion regulation; health-care utilization; somatization

Introduction

Sickle-cell disease (SCD) is a genetic disorder that occurs in about 1 of every 500 African-American births and more than 1 of every 36,000 Latino-American births (National Heart, Lung, and Blood Institute, 2009). SCD is characterized by severe, often unpredictable, pain episodes or “crises” that may require hospitalization. Among adults, several psychosocial correlates of hospitalization and use of other hospital services (e.g. emergency department (ED) use) have been identified. Extant work has documented a relationship between more frequent pain episodes and use of hospital services (e.g. Aisiku et al., 2009). Increased hospital services utilization has also been linked with maladaptive coping (Gil et al., 1989), somatization (typically defined as “medically unexplained symptoms”) (Sogutlu et al., 2011), somatic awareness (i.e. perception of minor bodily experiences) (McCrae and Lumley, 1998), and negative affect (NA) (McCrae and Lumley, 1998; Porter et al., 2000); positive mood has been associated with less utilization (Gil et al., 2004). Although stress was linked with hospital services use in one study (Porter et al., 2000), others failed to support this relationship (Gil et al., 2004; Porter et al., 1998). Similarly, no association was found between catastrophizing and utilization (Citero Vde et al., 2007) or between depression (Grant et al., 2000; Levenson et al., 2008) or anxiety (Levenson et al., 2008) and health-care use in adults with SCD.

Few investigations have examined psychosocial correlates of health services utilization among youth with SCD. One study found that child social adjustment, specifically

friendship quality, predicted ED visits (Brown et al., 2006). Other work suggested that overutilization of ED services was attributable to maladaptive coping skills in adolescent patients (Walco and Dampier, 1987). Accordingly, passive coping has been linked with more ED visits and active coping with fewer ED visits in youth with SCD (Gil et al., 1991). Moreover, increases in negative mood and stress were associated with more ED visits, whereas increases in positive mood were associated with fewer ED visits in adolescent patients, although these relationships were not found for hospitalizations (Gil et al., 2003).

Despite a connection between mood and hospital services use among youth with SCD, existing research has yet to examine the role of emotion regulation, that is, the strategies people use to influence the occurrence, intensity, and expression of emotion. Emotion regulation processes have received increasing attention in the study of child health outcomes. A recent investigation found that difficulties with regulating emotions were associated with increased pain and poorer functioning in youth with juvenile idiopathic arthritis (JIA) (Connelly et al., 2012). In children, emotion regulation is often measured using the Emotion Regulation Questionnaire–Child/Adolescent Version (ERQ-CA) (Gullone and Taffe, 2012) that assesses both maladaptive emotion regulation, that is, attempts to suppress negative emotion (emotional suppression), and adaptive emotion regulation, that is, construing the situation in a way that its emotional impact is reduced (reappraisal). Emotional suppression has been previously associated with increased acute laboratory pain responses (Cioffi and Holloway, 1993; Sullivan et al., 1997).

Somatization has also been closely linked with pain in child samples (Creed, 2009; Tsao et al., 2009), and as noted above, somatization has also demonstrated associations with increased use of hospital services among adults (Sogutlu et al., 2011). Yet, prior work has not examined the relationship between somatization and hospitalizations for pain crises among youth with SCD. Thus, the aim of this study was to investigate the relationships among emotion regulation, somatization, positive affect (PA) as well as NA, and the frequency of hospitalization for pain crises in a sample of youth with SCD. It was hypothesized that these constructs would demonstrate significant associations with hospitalizations after controlling for relevant clinical and demographic variables. Specifically, it was hypothesized that more emotional suppression, less reappraisal, more somatization, and more PA as well as less NA would be associated with more frequent hospitalizations for pain crises in this cohort.

Materials and methods

Participants

Recruitment was conducted by a community-based organization in Southern California. Eligible participants received flyers and were invited by a coordinator to participate in this study. This study was approved by the institutional review board of the university where the research was conducted. Youth were eligible to participate if they were (1) between the ages of 10 and 17 years; (2) diagnosed with SCD; (3) able to speak, read, write, and understand English; and (4) able to use a computer. They were excluded if they had major cognitive or neurological impairments (as reported by parents) that may have impacted their ability to understand and complete the study procedures.

A total of 76 youth were enrolled between April 2010 and December 2010. Eighty-five youth were scheduled to participate but did not attend their scheduled appointment. No children were excluded from the study enrollment. The sample was predominantly African-American (94.5%) and the remainder was Latino White; 53.4 percent were females. Additional demographic information is shown in Table 1. Of the 76 youth enrolled in this study, 7 (9.2%) were missing data on hospitalizations. The analyses were conducted on a

final sample of 69 youth. Data on hospitalizations were based on parent report (see section “Measures”). The number of hospitalizations for pain crises was categorized into two groups representing frequent and infrequent hospitalizations. This categorization was based on the data indicating that patients with three or more hospitalizations for pain crises per year demonstrated lower parasympathetic activity and greater sympathovagal imbalance compared to patients hospitalized fewer than three times per year (Nebor et al., 2011). Similar categorizations have been employed previously (Phillips et al., 1991; Platt et al., 1991)—for example, whereas 5.2 percent of patients had three or more hospitalizations per year, this group experienced nearly one-third of all pain crises (Platt et al., 1991). The majority of the current sample ($n = 51$; 73.9%) reported infrequent hospitalizations for pain crises in the previous 12 months (<3 hospitalizations), whereas just over a quarter of the sample ($n = 18$; 26.1%) reported frequent hospitalizations for pain crises in the previous 12 months (>3 hospitalizations; Table 1).

Although there are many types of SCD (Kohne, 2011; Steinberg, 2008), the most common types are (1) sickle-cell anemia (hemoglobin SS type or HgbSS), the most severe type, with the hallmark signs of frequent, severe pain crises, acute organ syndromes, and chronic hemolytic anemia; (2) sickle-cell hemoglobin C (HgbSC), variable in severity, with weak symptoms of SCD and chronic hemolytic anemia; (3) sickle beta⁺ thalassemia (HgbSβ⁺), also variable in severity; and (4) sickle beta^o thalassemia (HgbSβ^o), which is more severe in terms of anemia, often requiring chronic blood transfusions. The HgbSC type may cause similar symptoms as HgbSS but with less anemia due to the higher hemoglobin level. The severity of SCD varies according to the amount of normal and abnormal beta globin produced. In this study, we examined three categories of SCD type: HgbSS, HgbSC, and Other type. Patients with HgbSβ^o, HgbSβ⁺ thalassemia, and unknown type were categorized as Other Type due to small cell sizes.

Procedures

After obtaining informed consent/assent, youth individually completed questionnaires using a computer in a private area at the organization site. An assistant was available in the room in the event that participants had questions. Only those questionnaires relevant to the current study are discussed herein. Parents completed a paper-and-pencil questionnaire assessing demographic and hospitalization information (described below) in a separate room. Children received a US\$30 gift card for their participation.

Measures

Hospitalizations, clinical, and demographic characteristics—Parents completed a questionnaire that assessed the child’s sex, age, SCD type, as well as the number of times the child was hospitalized for pain crises in the 12 months prior to the study enrollment, and the number of times the child experienced a pain crisis that did not require hospitalization in the previous year. The latter served as a measure of pain during the study period.

Positive and Negative Affect Scale for Children—Positive and Negative Affect Scale for Children (PANAS-C) (Laurent et al., 1999) assesses the extent to which youth have felt various feelings and emotions in the prior few weeks. The two subscales are PA (interested, excited, happy, etc.) and NA (sad, frightened, ashamed, etc.). Each item is rated on a 1- (very slightly or not at all) to 5-scale (extremely). Scores range from 12 to 60 (PA) and 15 to 75 (NA). The PANAS-C has demonstrated reliability and validity in both community and clinical samples (Laurent et al., 1999).

Children’s Somatization Inventory–24-item version—Children’s Somatization Inventory– 24-item version (CSI-24) (Walker et al., 2009) assesses children’s perceptions of

somatic symptoms. Respondents rate how much they were bothered by each of the 24 symptoms (e.g. nausea) during the past 2 weeks using a 5-point scale (*not at all* to *a whole lot*). Scores range from 0 to 96, higher scores indicating more somatic symptoms. The CSI-24 has demonstrated reliability in clinical populations (Walker et al., 2009). It includes six pain items, four of which represent pain symptoms frequently present among children with SCD (Jacob et al., 2003). As noted by Sogutlu et al. (2011), a scale including these pain items may, in part, assess SCD disease severity rather than somatization. Thus, the items for these four common pain sites (i.e. back, stomach, chest, and limb) were excluded, and the revised measure (CSI-24SCD) was used to assess somatization. Cronbach's alpha for the CSI-24SCD was .89, indicating high internal consistency.

ERQ-CA—The ERQ-CA (Gullone and Taffe, 2012) assesses the use of two emotion regulation strategies: reappraisal (six items; e.g. “When I want to feel happier, I think about something different”) and suppression (four items; e.g. “I keep my feelings to myself”). Items are rated on a 1- (strongly disagree) to 5-scale (strongly agree). Scores range from 6 to 30 (reappraisal) and 4 to 20 (suppression), higher scores indicating greater use of the emotion regulation strategy. The ERQ-CA has demonstrated sound psychometric properties (Gullone and Taffe, 2012)—the reliability coefficient for the reappraisal and suppression subscales was .83 and .75, respectively. The ERQ-CA has shown convergent validity with established measures of depression and personality.

Statistical analyses

Preliminary analyses tested for differences between the frequent and infrequent hospitalization groups and the psychosocial variables based on SCD type, age, sex, and race/ethnicity. Independent *t*-tests were used for continuous data and chi-square tests for categorical data, and age effects were examined by calculating Pearson's correlation coefficients. To test for differences based on SCD type, one-way ANOVAs were conducted; significant omnibus effects for the ANOVAs were further examined using Tukey's honestly significant difference (HSD) post hoc tests. Bivariate analyses were then conducted to compare the hospitalization groups on the psychosocial variables using a series of independent *t*-tests. Associations among the psychosocial variables were examined using Pearson's correlations. Multivariate analyses were then conducted using sequential logistic regression analyses. Demographic/ clinical variables identified in the preliminary analyses as well as pain were entered simultaneously in Step 1, whereas psychosocial variables identified in the bivariate analyses as showing a significant relationship with hospitalization group were entered simultaneously in Step 2. The dependent variable (hospitalization group) was coded as “0” for infrequent hospitalization and “1” for frequent hospitalization. A standard probability level of .05 was used to evaluate the results.

Results

Preliminary analyses

Table 1 displays the demographic and clinical data for each hospitalization group and the total sample. The frequent and infrequent hospitalization groups did not differ with regard to age, sex, race/ethnicity, or SCD type. Similarly, there were no differences in these demographic/ clinical variables for somatization, PA/NA, emotion regulation, or pain. Age was not correlated with any of the psychosocial variables. For somatization, there was a significant overall difference based on SCD type ($F(2, 66) = 3.95, p < .03$). Post hoc tests indicated youth with HgbSC type scored higher on somatization ($M = 22.9$, standard deviation (SD) = 10.7) than those with HgbSS ($M = 13.6$, SD = 10.9) ($p < .03$); there were no other significant group differences although youth with Other type scored intermediate to the other groups ($M = 14.1$, SD = 12.6).

Bivariate analyses

Table 2 shows the descriptive data for the psychosocial variables for each hospitalization group and the total sample. Relative to the infrequent hospitalization group, the frequent hospitalization group reported more pain ($t(64) = -2.75, p < .01$), higher somatization scores ($t(67) = -2.63, p < .02$), and higher emotional suppression scores ($t(67) = -2.32, p < .03$). The groups did not differ on reappraisal or PA/NA. Table 3 shows the bivariate correlations among the psychosocial variables. As shown in Table 3, pain was not associated with any other psychosocial variable. Somatization was positively correlated with emotional suppression and NA, reappraisal was positively correlated with suppression and PA, and suppression was positively correlated with NA.

Multivariate analyses

The results of the sequential logistic regression are presented in Table 4. Step 1 variables were SCD type and pain, whereas Step 2 variables were emotional suppression and somatization. There was a good model fit (discrimination between groups) ($\chi^2(7) = 6.90; p = .44$; log likelihood = 53.94); the overall model explained 25 percent of the variance in hospitalization group membership (Cox and Snell R^2). As shown in Table 4, inclusion of Step 1 variables significantly improved model fit. Among Step 1 variables, only pain was significantly related to hospitalization group. The significant odds ratio (OR) indicated for every 1 unit increase in pain, the likelihood of being the frequent hospitalization group increased by a factor of 1.16. Inclusion of emotional suppression and somatization at Step 2 reliably improved the model fit.

The significant OR displayed in Table 4 indicated that for every 1 unit increase in emotional suppression, the likelihood of being the frequent hospitalization group increased by a factor of 1.25; for every 1 unit increase in somatization, the likelihood of being the frequent hospitalization group increased by a factor of 1.07. These results indicate that emotional suppression and somatization each explained significant variance in hospitalization group membership over and above that accounted for by the number of pain crises and SCD type.

Discussion

Consistent with this study hypothesis, multivariate analyses indicated that in this sample of youth with SCD, emotional suppression and somatization were significantly associated with more frequent hospitalization for pain crises, after controlling for SCD type and pain (see Table 3). Emotional suppression and somatization each accounted for significant variance in hospitalization group membership over and above that explained by pain and SCD type. While pain was also significantly related to frequent hospitalizations, SCD type was not associated with frequent hospitalizations. The overall model accounted for 25 percent of the variance in hospitalization group membership. Contrary to expectation, there were no associations between hospitalization group and PA/NA or the adaptive emotion regulation strategy of reappraisal.

Emotional suppression

The findings of this study partially agree with an investigation of children with JIA, which found that greater daily instability/variability of negative emotion was linked with increased pain and more functional limitation, whereas the attenuation of high levels of negative emotion predicted reduced pain and better functioning (Connelly et al., 2012). Although this prior study did not directly assess the strategies children used to regulate their emotions, it suggests that difficulties with regulating negative emotions are linked with poorer health outcomes, whereas adaptive regulation is associated with better health outcomes. However, in this study, we did not find a relationship between reappraisal and hospitalizations. The

reasons for the null findings are unclear. Despite data supporting the positive effects of reappraisal on emotional and physiological responses (Gross, 2001), no clear link between reappraisal and pain has been established. Nevertheless, our findings replicated prior work among adults (Sogutlu et al., 2011) in that even after excluding common pain complaints and controlling for the number of pain crises, somatization was linked with increased hospitalizations among youth with SCD. Our null findings for PA/NA are also consistent with the work reporting no relationship between mood and hospitalizations (Gil et al., 2003).

To our knowledge, no prior research has linked emotional suppression and health-care utilization in patients with SCD. Although we are not able to discern *how* emotional suppression may lead to more frequent hospitalizations, the present results are in line with the existing work pointing to adverse psychological effects of emotional suppression (Gross and John, 2003). Laboratory studies indicate that efforts to suppress thoughts of pain during or prior to painful stimulation have resulted in increased pain severity relative to nonsuppression (Cioffi and Holloway, 1993; Sullivan et al., 1997). Thus, emotional suppression may lead to increased pain severity that may result in a greater propensity to seek hospital services for pain.

Another possible means by which emotional suppression may increase hospital service use is via physiological effects. Laboratory investigations indicate that emotional suppression is accompanied by increased sympathetic and cardiovascular responding (e.g. Egloff et al., 2006), suggesting that emotional suppression may exert adverse effects on health via physiological mechanisms. McCrae and Lumley (1998) suggested focusing on the potential role of sympathetic arousal in precipitating or exacerbating painful SCD episodes. They maintain that emotion-induced sympathetic activation alters respiratory and blood flow patterns, possibly increasing the probability of vascular occlusion. Since emotional suppression promotes cardiovascular and sympathetic activation, it is possible that it may lead to increased episodes of vascular occlusion. These possibilities remain speculative, however, and may be tested in future research.

Somatization

Despite widespread recognition of the adverse impact of somatization, it has rarely been examined in the context of chronic diseases such as SCD that cause multiple physical symptoms (Sogutlu et al., 2011). Somatization has been defined as the experience of medically unexplained symptoms (Sogutlu et al., 2011). However, for diseases like SCD determining whether symptoms are “medically unexplained” may be problematic with questionable reliability and validity in discerning the attribution of symptoms to medical versus nonmedical causes (Sogutlu et al., 2011). According to Kroenke et al. (2010), both physical and psychological factors appear to contribute to somatic symptom reporting, even among those with chronic medical problems. Moreover, even after accounting for medical and psychiatric comorbidity, somatic symptoms themselves are linked with disability and health-care use (Harris et al., 2009). Thus, Kroenke et al. maintain that the interaction between medical and psychological factors (rather than one set of factors *or* the other) contributes to the experience of somatic symptoms. In general, symptoms are the main reason why people seek health care (Kroenke, 2001), and thus high symptom levels, whether attributable to a specific disease or not, may lead to increased health-care utilization. In this study, higher levels of nonpainful symptoms were linked with more frequent hospitalizations even though such symptoms were not associated with the number of pain crises (see Table 2). These results suggest that the propensity to report nonpainful symptoms is at least partially independent of disease severity, but that this propensity remains a risk factor for hospitalization during pain episodes.

Several caveats to our findings should be mentioned. This investigation was not longitudinal and thus causality cannot be inferred. We relied on parents' retrospective reports of both hospitalizations and the number of pain crises not requiring hospitalization in the prior year. Thus, we did not include children's own assessment of pain that would have yielded additional and more precise information regarding their pain experience and may have led to different findings. Although hospitalizations and pain crises are discrete events that may be more likely to be recalled, the use of daily diary methodology may yield more accurate data. Relatedly, we did not include daily assessments of mood or pain. A possible reason for our null findings for PA and NA is that we used a single retrospective measure that asked participants about feelings and emotions "over the past few weeks." As noted above, previous work using daily diaries found that mood states were associated with ED visits among youth with SCD (Gil et al., 2003). Inclusion of daily assessments of chronic noncrisis pain may also have yielded additional information. Prior research indicates that the frequency and severity of noncrisis pain are associated with greater ED use in SCD patients (Aisiku et al., 2009). We did not assess the use of health-care services other than hospitalizations, and such utilization may have been linked with different psychosocial constructs. Finally, we did not include parent psychosocial data; Brown et al. (2006) found that parent psychosocial adjustment predicted ED visits for their children's SCD pain.

Ultimately, research identifying psychosocial correlates of health-care utilization has the potential to inform interventions aimed at reducing the use of hospital services among youth with SCD. Our results suggest that efforts to address emotional suppression and somatization in such patients may assist in decreasing the frequency of hospitalizations for pain crises. Recent work supports the use of acceptance-based psychological treatments assisting children with chronic pain to manage negative emotions without ineffective resistance or struggling (Gauntlett-Gilbert et al., in press). Although such interventions have not yet been tested in youth with SCD, the findings of this study suggest that this type of therapy may assist children who use suppression to manage negative emotions. These efforts should target youth with SCD who experience frequent hospitalizations, as our work, and that of others (Aisiku et al., 2009; Platt et al., 1991) indicates that a relatively small proportion of patients account for the majority of hospital admissions.

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Table 1

Demographic and clinical data by hospitalization group and the total sample

	Infrequent (<i>n</i> = 51)	Frequent (<i>n</i> = 18)	Total sample (<i>N</i> = 69)
Sex (female – <i>n</i> (%))	28 (54.9%)	10 (55.6%)	38 (55.1%)
Mean age in years (SD)	13.6 (1.9)	12.7 (2.2)	13.4 (2.0)
Ethnicity (<i>n</i> (%))			
African-American	47 (92.2)	18 (100)	65 (94.2)
Latino White	4 (7.8)	0 (0)	4 (5.8)
SCD group (<i>n</i> (%))			
HgbSS	23 (45.1)	10 (55.6)	33 (47.8)
HgbSC	11 (21.6)	5 (27.8)	16 (23.2)
Other	17 (33.3)	3 (16.7)	20 (29.0)

SCD: sickle-cell disease; HgbSS: hemoglobin SS type; HgbSC: hemoglobin SC type; Other: other type (i.e. hemoglobin S β^o , hemoglobin S β^+ thalassemia, and unknown type); SD: standard deviation.

Table 2

Means (standard deviations) of the psychosocial measures by hospitalization group and the total sample

	Infrequent (<i>n</i> = 51)	Frequent (<i>n</i> = 18)	<i>p</i> value	Total sample (<i>N</i> = 69)
Pain (number of pain crises)	4.6 (5.8)	10.6 (11.8)	.008**	6.1 (8.0)
Somatization (CSI-24SCD)	13.8 (10.7)	21.9 (13.1)	.011*	15.9 (11.8)
Reappraisal (ERQ-CA)	19.3 (4.5)	20.1 (3.7)	.536	19.5 (4.3)
Suppression (ERQ-CA)	10.9 (3.2)	12.9 (3.4)	.023*	11.4 (3.3)
Positive affect (PANAS-C)	39.6 (13.3)	38.8 (12.7)	.844	39.4 (13.1)
Negative affect (PANAS-C)	25.6 (11.1)	27.2 (11.9)	.609	26.0 (11.2)

SCD: sickle-cell disease; CSI-24SCD: Children's Somatization Inventory 24-item version with SCD-related pain items removed; ERQ-CA: Emotion Regulation Questionnaire–Child/Adolescent Version; PANAS-C: Positive and Negative Affect Scale for Children.

Groups are significantly different

*
 $p < .05$;

**
 $p < .01$.

Table 3

Bivariate correlations among the psychosocial measures

	Pain	Somatization (CSI-24SCD)	Reappraisal (ERQ-CA)	Suppression (ERQ-CA)	Positive affect (PANAS-C)	Negative affect (PANAS-C)
Pain						
Somatization (CSI-24SCD)	-.06					
Reappraisal (ERQ-CA)	-.06	.11				
Suppression (ERQ-CA)	-.07	.31*	.33**			
Positive affect (PANAS-C)	.01	-.08	.41**	-.15		
Negative affect (PANAS-C)	-.23	.42**	-.02	.25*	-.17	

SCD: sickle-cell disease; CSI-24SCD: Children's Somatization Inventory 24-item version with SCD-related pain items removed; ERQ-CA: Emotion Regulation Questionnaire-Child/Adolescent Version; PANAS-C: Positive and Negative Affect Scale for Children.

* $p < .05$

** $p < .01$.

Sequential logistic regression of SCD type, pain, emotional suppression, and somatization on hospitalization group

Table 4

Step	Independent variable	β	<i>p</i>	Odds ratio	95% CI	χ^2 to remove	<i>df</i>	Sig.
Step 1	HgbSS	.89	.31	2.43	0.43–13.57			
	Other	–.39	.71	0.67	0.09–5.31			
	HgbSC (reference)							
	Pain	.14	.01	1.16	1.03–1.29	7.95	3	.05
Step 2	Emotional suppression	.22	.04	1.25	1.01–1.55			
	Somatization	.07	.04	1.07	1.00–1.14	11.21	5	.002

HgbSS: hemoglobin SS type; HgbSC: hemoglobin SC type; Other: other type (i.e. hemoglobin S β^0 , hemoglobin S β^+ thalassemia, and unknown type); β : standardized regression coefficient; *p*: probability; CI: confidence interval; χ^2 to remove: improvement in model fit when predictors comprising each step are removed; *df*: degrees of freedom; sig.: significance level.