Emotional Regulation and Adjustment to Childhood Cancer: Role of the Biological, Psychological and Social Regulators on Pediatric Oncology Adjustment

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Abstract

Background: Children with cancer should deal with difficult situations such as undergoing multimodal treatment. Emotion Regulation Mechanisms (ERM) could be more effective for childhood cancer adaptation. The main purpose of this study was examination a number of the biological, psychological and social emotion regulators on adjustment to pediatric oncology.

Method: In this study, 98 children (39 girls and 59 boys) have participated that diagnosed as Acute Lymphoblastic Leukemia (ALL) cases along with their mothers. The participants were between 8 to 12 years old. Salivary cortisol, cognitive emotion regulation, children's level of inhibition, maternal positivity and Beck Depression Inventory have been applied for evaluation of Emotion Regulation (ER) while Cancer-Specific Stress and Coping, Connor–Davidson Resilience Scale, anxiety-depression scales and vitality test have all used for assessing the Emotional Adjustment (EA).

Results: Using the canonical correlation has been showing significant relation between predictors of ER and EA. Cortisol level and mother's depression have played the most important role in above correlation.

Conclusion: Variation of cortisol level has identified by its various effects on the mother's behavioral system depression, cognitive strategies and emotional inhibition; would determine the rate of coping with cancer, resiliency and vitality.

Keywords: Child; Malignancy; Emotions; Adaptation

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Introduction

Studies have emphasized that childhood cancer survivors would be at high risk of cognitive and social consequences due to the late effects of their treatment [1,2]. Incredibly, according to other research findings, canceric children emotionally have well adapted in comparison to normal children or other medical conditions [3]. In some of cancer face children; medical stressors have observed as well as sudden onset of physical illness, and treatment injuries [4]. They have often undergone multimodal treatment including surgeries, chemotherapy and radiation, which might cause numerous long-term acute side effects. Painful procedures, hospitalizations and uncertain prognosis would be common stressors that could pose a substantial threat to the adjustment of children and families [5]. Despite various traumas, the prevalence of psychopathology such as depression and Post-Traumatic Stress Disorder (PTSD) have recognized in general population [6]. Furthermore, when children have usually been informed of their conditions; then they have worried of being lonely, stigmatized, discriminated against and even death eventually [7]. Therefore, the most important question could be" How children with cancer should deal with myriad of the stressors". It is hypothesized here that Emotion Regulation Mechanisms (ERM) could be more effective for childhood cancer adaptation. The effects of different ERM such as biological, psychological and maternal mechanisms for well adjustment have been examined in this paper.

ER refers to modulate one or more components of emotions meant to decrease the intensity and

duration of that initial negative emotion by applying cognitive and behavioral strategies, modifying emotion-eliciting situation then seeking for a caregiver [8]. Researchers have demonstrated that dysregulation of emotions such as aggression, non-expression of emotions; emotion suppression and alexithymia have led to health problems in children [9]. Cumberland-Li believes that children could manage; not only their emotions internally (by psychological process), but also externally (by adults).

ER has affected by physiological activity such as neuroendocrine systems (et. cortisol level). Biological systems have not distinct from emotions [10]. One of the chemotherapy side effects among the children with Acute Lymphoblastic Leukemia (ALL) is cortisol suppression [11]. Cortisol variation potentially changes strength and stability of emotions [12]. Therefore, variation of cortisol level operates as an emotion regulator.

Cognitive strategies play an important role in the adjustments to stress in children with cancer. Distraction as the common cognitive technique has been used from infancy through adulthood, particularly when it is not possible to change or modify one's situation [13, 14]. When such patients have advanced in age, they could appraise stressful situations. Their perspective to adverse situations determines the adjustment rate.

Children initially rely on interaction with their caregivers to regulate their emotions. Researchers have increasingly examined the relations between parental style with children's dispositional control due to self-regulation, impulsivity and children's maladjustment [15]. Cumberland-Li, in his investigation has shown that parents' emotionality is associated with their children's ER capacities [9]. Specifically, associations between mothers' negative emotionality and their children's externalizing and internalizing problems have mediated by the low positive emotion of mothers [15].

In the present study, the relation between ERM and adjustment to cancer has investigated. Cortisol level as the biological emotional regulation, cognitive strategies and inhibition of emotions as psychological methods and maternal positivity have applied as maternal regulator in this paper. Adjustment to childhood cancer has identified as coping with cancer, resiliency, anxiety/depression and vitality.

Materials and Methods

Two hundred and eighty- seven children with Acute Lymphoblastic Leukemia (ALL) and their mothers have involved in this research. Potential participants have identified from the "chemotherapy room" outpatient list. Eligibility criteria were as below (1) children must be between 8 and 12 years old; (2) their illness has diagnosed as Acute Lymphoblastic Leukemia (ALL) (3) they have currently undergone chemotherapy. From the initial list of 300 potential participants, 296 children and their mothers have met the eligibility criteria. Among these potential participates, 287 mothers along with their children have agreed to take part in this study. The most common reason of "refusing the research" was serious medical complications. Table 1 containe information such as age, gender and stage of cancer.

Measures
Cortisol

The measurement of cortisol in saliva reliably reflects physiological active free cortisol levels in blood, since unbound plasma cortisol diffuses easily from blood to saliva. Salivary samples have collected using the Salivate system from Started and then centrifuged. Cortisol kits have refrigerated until retrieved by a research assistant and radioimmunoassay has carried out using commercial reagents from Diagnostic Systems Laboratories, inc. Samples have stored at 50C until EIA kits from Sal metrics, Inc. have applied. The intra-assay coefficients of variation for low and high controls were 3.2 and 0.8% respectively, while the inter-assay values were 4.03 and 1.5%, respectively as well. Mean (range) morning salivary cortisol in participants was 11.5 (1.3-27.7) nmol/l. The value of 12 nmol/l for the lower limit of a normal stimulated cortisol in saliva has chosen as all patients tested at baseline had a normal stimulated s-cortisol > 500 nmol/l and a stimulated cortisol in saliva > 12 mol/l. There were no differences between patients and controls for average sample time for any time point (all p's > 0.32), and no differences in variance of sample times for patients and controls (all p's > 0.24).

Cognitive Emotion Regulation

Cognitive emotion regulation has measured by the Cognitive Emotion Regulation Questionnaire Kid's version (CERQ-k) [16]. This questionnaire has developed to assess what children tend to think after experiencing negative life events. The CERQ-k consists of 36 items. The answer categories for each of the items range from 1 [(almost) never] to 5 [(almost) always]. The minimal score was 4, then the maximum score 20. The higher the sub-scale score, the more the specific cognitive strategy has used. The

Table 1. Demographic and disease characteristics

Variables	%	M	SD
Age in year		3 years	0.82
Sex			
Male	53		
Female	47		
Months since diagnosis		28 months	0.34
Age of diagnosis			
Early childhood	36.2		
School age	63.8		
Stage of illness			
Newly diagnosis	56.8		
Relapsed	43.20		
Cortisol Level			
Low	41.65		
Normal	47.31		
High	11.04		

Table 2. Canonical salutation for ER and EA for function 1 and 2

Variables	9	8	7	6	5	4	3	2	1
Cortisol	0.62	0.89	-0.64	-0.81	0.71	-0.76	-0.83	-0.87	1
Cognitive strategies	0.66	-0.85	0.78	0.83	-0.74	0.69	0.53	1	
inhibition	-0.61	0.60	0.88	0.78	0.57	0.54	1		
Maternal positivity	0.92	-0.89	0.86	0.83	-0.96	1			
Mother's depression	0.89	0.94	-0.92	-0.87	1				
Coping to cancer	0.55	-0.68	0.79	1					
Resiliency	0.57	-0.86	1						
Anxiety/Depression	-0.81	1							
Vitality	1								

Table 3. Pearson Correlations among variables of interest

Variables	Function 1			Function 2			
	Coef	r_s	r_s^2 (%)	Coef	r_s	r_s^2 (%)	h^2 (%)
Cortisol	0.45	0.75	56.25	1.34	0.57	33.64	92.14
Cognitive strategies	0.48	0.49	29.01	0.73	0.68	24.8	53.81
inhibition	0.49	0.58	33.99	0.136	0.577	32.95	66.94
Maternal positivity	0.44	0.78	60.15	0.79	0.39	17.52	77.67
Mother's depression	0.87	0.98	84/76	0.09	0.43	1.22	87.98
Coping to cancer	0.34	0.67	45.83	0.29	0.02	0.05	45.88
Resiliency	0.57	0.72	51.84	0.28	0.35	12.67	64.51
Anxiety/Depression	0.24	0.61	42.38	0.004	0.29	8.41	50.79
Vitality	0.163	0.1	0.1	0.55	0.81	64.16	65.16

sub-scales were: Self blame, Other-blame, Acceptance, Planning, Positive Refocusing, Rumination or focus on thought, Positive reappraisal, putting into perspective and Catastrophizing. All shown sub-scales have contained good internal consistencies, ranging from 0.68 to 0.85. Validity of CERQ-k has calculated 0.97 and reliabilities of the depression, anxiety and horror scales were high; 0.81, 0.84 and 0.97, respectively. Three sub-scales had alphas between 0.65 and 0.70, putting into perspective and positive reappraisal.
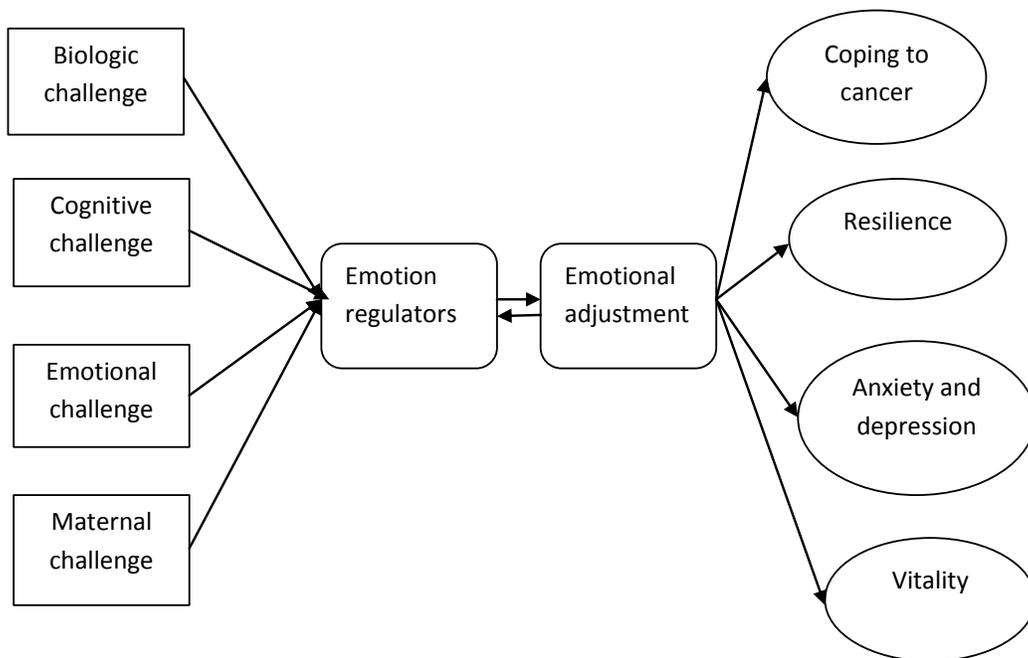
Children's Level of Inhibition

Figure 1. A full model of canonical correlation between emotion regulators and emotional adjustment

Children's level of inhibition has coded globally on a 4-point scale (1 shows no inhibition; 4 shows much inhibition) [17]. The rating has based on all incidents as expressed below: 1) the lack of approach to playing (e.g., when a child does not touch neither play with the toys, nor walks around the toys); 2) anxiety, wary expression or behavior (e.g., when a child is timid or fearful); and 3) reluctance, hesitant response to the stranger (e.g., child retreats from the stranger, freezes, avoids eye contact). The inter-rater reliability was 0.88 based on 10% of cases coded by two raters. Children who have assessed at different ages have compared; no differences in levels of inhibition have found [18].

Maternal Positivity

Children and their mothers have participated in a 25-minute mother–child interaction, which consisted of a series of 4–5 tasks designed to elicit positive and negative effects in children [19]. Each task has involved mother and child playing together. Maternal and child behaviors have coded in two ways, based on the occurrence of a behavior in 10-second intervals while using a global rating scale. For this study, a factor of maternal positivity has generated based on one interval code and four global codes that reflect mothers' warmth, supportiveness and involvement with their children. The interval code of maternal positive effect reflects mothers' positive gesture (e.g. smiling, laughing,

kissing and hugging) and verbal comments indicating the approval statement of, or fondness towards the child; the number of intervals in which mothers displayed positive effect towards children has recorded. Four global codes have included, all rated on a 4-point scale with higher scores indicating greater frequency of the maternal behavior being rated vis-a-vis: 1) maternal positivity towards child 2) maternal quality as a teacher, (e.g. explaining the tasks, providing feedback and suggestions, making the tasks interesting) 3) maternal sociability-indicating mothers' warmth and friendliness towards children; and 4) maternal involvement with child, (e.g., maintaining eye contact and conversation). Cronbach's alpha for this 'maternal positivity' index has 0.73. Inter rater reliability has calculated based on 15% of tapes coded by at least two coders. Reliability was 0.63 (kappa) for the interval code, and 0.72, 0.62, and 0.70 (intraclass correlations) for maternal positivity, quality as a teacher, and sociability respectively. For maternal involvement, because all but one of mothers has received ratings of 3 or 4, and kappa has calculated.

Beck Depression Inventory (BDI)

Beck Depression Inventory (BDI) [20] has applied for the mothers who participated. The BDI is a well established 21-item measure assessing current depressive symptomatology, yielding total scores with a potential range from 0 to 63. A meta-analysis

of the BDI's internal consistency estimates yielded a mean coefficient alpha of 0.86 for psychiatric patients and 0.81 for non-psychiatric subjects. The concurrent validity of the BDI with respect to clinical ratings and the Hamilton Psychiatric Rating Scale for Depression (HRSD) were also high. The mean correlations of the BDI samples with clinical ratings and the HRSD were 0. 72 and 0.73, respectively, for psychiatric patients. With non-psychiatric subjects, the mean correlations of the BDI with clinical ratings and the HRSD were 0.60 and 0.74, respectively.

Cancer-Specific Stress and Coping

Mothers completed the Pediatric Cancer Version of the Responses to Stress Questionnaire (RSQ) , a 57-item measure that uses a four-point scale to assess three dimensions of voluntary coping: (a) primary control engagement (problem solving, emotional expression, emotional modulation), (b) secondary control engagement (cognitive restructuring, positive thinking, acceptance, distraction), and (c) disengagement (avoidance, denial, wishful thinking). The RSQ also assesses perceived cancer-related stress on a four-point scale, resulting in a total stress summary score. Acceptable reliability and validity have been noted, and correlations between parent and child self-report of coping reflect small to medium effects ($r = 0.23–0.33$). Internal consistency of the sample ranged from 0.71 to 0.82 for the three coping dimensions and the perceived stress scale [21].

Connor–Davidson Resilience Scale

The Connor Davidson Resilience Scale [22] is a 25-item scale that measures the ability to cope with adversity. Respondents rated items on a scale from 0 (not true at all) to 4 (true nearly all the times). A preliminary study of the psychometric properties of the CD-RISC in general population and patient samples has supported its internal consistency, test–retest reliability and convergent as well as divergent validity. Reliability for the scale has a Cronbach alpha of 0.89. Test–retest reliability has demonstrated to have a high level of agreement, with a correlation coefficient of 0.87. The scale has been found to have convergent validity with other measures of hardiness, and results from studies conducted to test the reliability and validity of the CD-RISC have shown resilience to be a quantifiable construct.

Anxiety/Depression

Symptoms of anxiety and depression in children have assessed by the Child Behavior Checklist [23].

This parent-report measure includes 118 items scored on a three-point scale based on frequency in the past 6 months. The DSM-Oriented Scales for Affective Problems and Anxiety Problems have used to examine the symptoms of anxiety and depression separately. The CBCL has strong reliability and validity, and the agreement between parent and child report of internalizing symptoms on the CBCL and Youth Self Report (YSR) reflect medium to large effects ($r=0.39–0.48$).

Vitality

Children's Vitality Test entails a drawing exercise that meant for measuring the subjective vitality reflected in the drawings created by children [24]. This test has four components and seven items. For example, the force applied on the paper has shown the level of energy and the colors used indicate emotional disruption or emotional vitality. Every item takes score in 3-point scales based on the protocol. Also, Cronbach's alpha for the test has calculated as 0.83; $p<0.05$ which is suitable.

Results

Table 1 depicts demographic information of participants such as age, gender, months since diagnosis, age of diagnosis, stage of illness, cortisol level. With respect to the nature of the research data, the canonical correlation statistical test has selected. Canonical correlation is a multi-variable analysis which measures the relation between two series of predication and standard variables with the last type I and II errors. To execute this program, in the part of New Syntax, the program of this test has written and then it has run.

Age and gender have included as controls among the predictor variables in the canonical correlation analysis to determine the magnitude of their impact on the criterion variables.

The research model, as a full model has evaluated for statistical significance by Pillayis, Hotelling and Wilks Tests (Pillayis; F= 5.324, P<0.001), (Hotelling; F=6.2134, P<0.001) and (Wilks; F=6.876, P<0.001). The canonical correlation analysis has revealed two significant functions between the set of ER and EA variables (Rc = 0.69, Wilk's λ = 0.453, p < 0.001; Rc = 0.30, Wilk's λ = 0.856, p < 0.01; Rc = 0.25, Wilk's λ = 0.938, p < 0.05).

Table 2 presents the standardized canonical function coefficients (i.e., the weights) and structure coefficients for all variables across both functions. This table helps to understand the patterns among variables. The squared structure coefficients represent the percentage of shared variance

between the observed variable and the synthetic variable created from the observed variables' set. The last column lists the commonality coefficients ($h2$), representing the amount of variance in the observed variable that was reproducible across the functions. Commonalities above 45% have also underlined in order to show the variables with the highest level of usefulness in the model.

Canonical correlation determines which variables have more or less shares in addition to calculating the variables' relations. In the current, higher levels of cortisol among the other predictors have associated with poorer adjustment (canonical loading of 0.89). Furthermore, it appears as the strong relation between mother's depression and Covariates (EA variables) (canonical loading of 0.89). The main Covariates loading on the first canonical function for EA variables belonged to resiliency (canonical loading of 0.89) and vitality (canonical loading of 0.89). Instead of Table 2 that reflexes correlation between the two groups of variables, Table 3 shows the correlation between variables of study 2 to 2.

Discussion

Studies have shown that canceric children are susceptible to psychosocial disorders such as cognitive and social deficits, but their function emotionally has seemed well. These conflicts set the tone for this study to find some explanations. According to the findings of the present study, ERM in children with ALL relates to emotional adaptation. Canonical correlation provides a framework for understanding all correlations in the model and helps the genetically important variables. Based on the canonical correlation, the important factors in emotional adaptation as the predictors are as follows: cortisol level, mother's depression, resiliency and vitality.

Cortisol rate plays an effective role in adaptation. Cortisol level in the children has remained high when they were in a threatening situation [25], but one of the side effects of the chemotherapy drugs is cortisol suppression [26]. Almost 24.4% of participants have shown lower cortisol level than the normal rate. Variation of cortisol level, as a basic regulator, not only affects the quality of emotions such as vitality, but also determines coping with cancer and resiliency. In some previous studies, it has shown that children with ALL could recall more positive images than negative pictures and this positive attention bias has related to cortisol level. Based on this study and corroborated by other research findings, it could be concluded that lower cortisol level reduces cases of negative memory [27]. It should be noted also, that high cortisol suppression might have adverse effects on emotional adjustment.

Mother's depression plays an important role in this model. When the mother is under stress and cannot control her behaviors and emotions, she succeeds in confusing her child in the same version and situation. Robinson, Gerhardt, Vannatta, and Noll [28] found significant associations between parents and the distress of their children with cancer. The parent's distress condition has positively related to distress in the children. According to another study, children of depressed mothers have displayed above and beyond varieties of internalizing and externalizing physical symptoms [15]. The outcome of the study has shown that, fundamental psycho-pathology in a mother with a child that is ill greatly affects the child's adaptation. Findings have shown that depression in mother positively correlated with anxiety and depression in child and negatively related to resiliency and vitality. The clinical health psychologist could provide interventionist programs for mothers to improve children's health promotion. Physical contact with mother is an important predictor in emotion adaptation. Almost 73.1% of mothers have reported, when their children are in stress; try to calm them down by hugging [29,30]. A depressed mother is less likely to embrace her child under some critical situations. According to Bowlby [29, 30], the first attachment theorist, mothers who are available and responsive to their infant's needs establishing a sense of security infant. When the child feels threatened or afraid, he or she could return to the caregiver (mother) for comfort and soothing and the caregiver (mother) provides a safe and dependable haven for the child to feel secure [29, 30]. When the mother could not provide a sense of comfort and security, the child becomes very distressed and might not easily adapt to dilemmas related to cancer [31]. In addition, physical contact directly impacts on regulation of negative emotions. For example, Chiu and Anderson [32] have demonstrated that skin-to-skin contact between mothers and their infants would reduce the pain experienced by the little infants during heel lance and this reduces crying, grimacing, blunts heart rate increments and other physiologic pain indices.

Matured cognitive strategies such as acceptance, planning, positive refocusing and positive reappraisal have shown statistically high positive correlation as well as coping with cancer. Cognitive regulation is mediated by personal characteristics such as age, gender, IQ and social support [32]. The inhibition had a high positive relation to resiliency and coping. "Repressive adaptive style" that Phipps

[33] has brought forward, has shown that most of the children with cancer have shown high level of "repressive adaptive style" in comparison to normal children. Apparently, inhibition and repression of negative emotions are very similar. It is not obviously clear the reason for emotional inhibition in children with cancer, but the results have shown that the consequences are positive.

The present study has provided a holistic view to emotional adjustment for pediatric oncology. No factor could separately explain emotional adjustment to cancer. Furthermore, this study has implicitly shown that lack of emotional problem couldn't mean good adaptation. For this reason, positive variables such as vitality and emotional clarity have used in the work. Attention to these kinds of variables helps child health psychologists to improve happiness and vitality in children with chronic illness especially in those with cancer.

In addition, concerning on hormones as emotion regulators expand greatly our knowledge about mental and physical reactions of children to illness. One of the serious limitations of this study has focused on just one hormone. The study of homeostasis disruption due to illness and treatment opens the doors towards ED.

As proposed in this study, future researches might be used for the confirmatory analysis and determine the causal relationship between the variables of EM and ED.

Acknowledgment

Conflict of Interest

The authors have no conflict of interest in this article.

Authors' Contribution

Manijeh Firoozi and Mohammad Ali Besharat designed the study. Manijeh Firoozi collected the data and wrote the paper. Eshagh Rahimian Boogar contributed to data gathering.

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