

# Allostatic load in parents of children with developmental disorders: Moderating influence of positive affect

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## Abstract

This study examines whether parents of children with developmental disorders are at risk of elevated allostatic load relative to control parents and whether positive affect moderates difference in risk. In all, 38 parents of children with developmental disorders and 38 matched comparison parents were analyzed. Regression analyses revealed a significant interaction between parent status and positive affect: parents of children with developmental disorders had lower allostatic load when they had higher positive affect, whereas no such association was evident for comparison parents. The findings suggest that promoting greater positive affect may lower health risks among parents of children with developmental disorders.

## Keywords

allostatic load, developmental disorders, negative affect, positive affect

Parenting children with developmental disorders (DDs) is a life-long process that entails unique challenges and adjustments. Studies have shown that these parents usually experience chronic stress and are at elevated risk for mental health problems, although profiles of resilience have also been noted. Specifically, these parents experience high caregiving demands (Baker et al., 2003), and have lower levels of happiness, self-esteem, and sense of self-efficacy (Emerson et al., 2006), and increased depressive symptomatology (Olsson and Hwang, 2008) when compared with parents of children without such conditions. A previous study found that mothers of children with DD experienced more stressors on a

daily basis than comparison group parents whose children were unaffected (Seltzer et al., 2009). A meta-analysis of 18 studies revealed an approximately 10 percent increase in the prevalence of clinical depression in mothers of children with DD as compared to mothers of unaffected children (Singer, 2006).

Although researchers have investigated the effects of parenting children with DD on parents'

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mental health outcomes, there has been less focus on their physical health. In two studies examining this issue, elevated levels of chronic health problems were reported by older parents of adult children with DD. Yamaki et al. (2009) found a significantly higher prevalence of arthritis, high blood pressure, obesity, diabetes, high cholesterol levels, and activity limitations among middle-age caregivers of adults with DD than among controls. Seltzer et al. (2011) found that mothers and fathers of adults with DD reported higher body mass index, more musculoskeletal conditions, more activity limitations, and lower health-related quality of life in early old age than did their peers with healthy children.

Although these self-reported health conditions suggest elevated risk in older parents of adults with DD, a different approach for assessing the health impacts of parenting children with DD involves measurement of allostatic load (AL), a frequently used composite index generated from multiple biomarkers. AL is an indicator of the cumulative dysregulation of multiple physiological systems known to be sensitive to chronic exposure to life challenges, which eventually increases susceptibility to disease (McEwen and Stellar, 1993). McEwen and Seeman (1999) elaborated the steps whereby the wear-and-tear of life stress leads to increased AL, and ultimately progresses to disease pathology over the life course. Specifically, there are effects of stress on several hormone systems (e.g. cortisol and dehydroepiandrosterone (DHEA)), the autonomic nervous system (e.g. norepinephrine and epinephrine), as well as on cardiovascular functioning (e.g. blood pressure) and glucoregulation (e.g. blood sugar). The cumulative effect over time becomes evident both at the level of systemic physiology and at the levels of cellular, tissue, and organ functions.

The efficacy of AL as a cumulative index that can predict long-term health and disease has been demonstrated in several epidemiological studies (e.g. Seeman et al., 2002). Furthermore, the composite AL panel of biomarkers has a

better predictive power than do the individual markers that comprise the index (Seeman et al., 2002). AL has been associated with increased risk of cardiovascular disease (Karlamngla et al., 2002), all-cause mortality (Goldman et al., 2006), chronic fatigue syndrome (Maloney et al., 2009), poorer cognitive and physical functioning (Karlamngla et al., 2002), and poorer self-rated health (Hasson et al., 2009).

Previous studies have shown that psychosocial resources can alleviate the negative outcomes often experienced by parents of children with DD. This research has shown that personal psychological resources including self-efficacy (Kuhn and Carter, 2006), psychological acceptance (MacDonald et al., 2010), internal locus of control (Lloyd and Hastings, 2009), and active coping styles (Kim et al., 2003), as well as social resources, such as social support (Smith et al., 2011) and better marital quality (Kersh et al., 2006), can lessen the stress experienced by parents of children with DD. Studies also have identified a number of protective factors that promote resilience in the face of stressful life challenges and reduce the effects on AL. Economic resources, educational attainment, and social support all appear to mitigate some of the adverse effects of chronic life challenges on AL (see Juster et al., 2009, for a review). Notably, there has been a growing interest in the health benefits of positive psychological resources. Supportive relationships, the capacity to sustain a resilient and optimistic cognitive outlook, and positive affect are examples of beneficial psychological resources and are even able to offset the negative effects of stressful life circumstances (such as lower socioeconomic status (SES) at various life stages) on physiologic markers (Chen et al., 2011, 2012; Morozink et al., 2010). In a recent review of the studies from the countries in Europe, Asia, and North America, Boehm and Kubzansky (2012) reported that various types of positive psychological well-being (e.g. hedonic well-being, eudaimonic well-being, and optimism) were associated with a lower incidence of cardiovascular disease,

more restorative health behavior, and better biological functions regardless of the presence of other risk factors or ill-being. Specifically, research has consistently shown the health benefits of positive affect. Greater positive affect is associated with lower morbidity and mortality, less pain, better cardiovascular, endocrine and immune function, and better self-rated health (see Boehm and Kubzansky, 2012; Pressman and Cohen, 2005, for a review).

One study showed that being a caregiver to an Alzheimer's patient was linked to an increased level of AL among older family caregivers, and that mastery had a moderating effect on this association, although it showed that the caregivers with higher levels of mastery indicated higher levels of AL, contrary to expectation (Roepke et al., 2011). However, AL has not previously been investigated in parents of children with DD nor has the effect of positive affect as a moderating mechanism been explored. In the present study, we examine whether parents who have children with DD and therefore face life-long challenges have different levels of AL than control parents, and whether positive affect moderates such differences. This study draws on a unique set of a national probability data, Midlife Development in the United States (MIDUS), to avoid selection bias in identifying parents of children with DD and to take advantage of extensive biomarker data to examine associations with parenting status. Furthermore, the inclusion of a group of systematically matched comparison parents who did not have children with DD in the present analysis is an additional strength afforded by this approach.

Our hypotheses were as follows:

Hypothesis 1. Mothers and fathers of children with DD will have higher levels of AL than the matched comparison group of parents whose children are unaffected.

Hypothesis 2. Higher levels of positive affect will buffer the risk of elevated AL in parents of children with DD.

## Method

### Participants

The analyses utilize data from the MIDUS study, a survey of a national probability sample of noninstitutionalized, English-speaking adults at the age of 25–74 years in 1995–1996 (MIDUS I) and 2005–2006 (MIDUS II) (Brim et al., 2004).

In addition to the interview and questionnaire data, biological measures were collected from a subsample of MIDUS II participants during an overnight stay at a General Clinical Research Center (GCRC). A total of 1054 members from the main MIDUS II study (41.9% after adjusting for respondents who could not be located or contacted) participated in the GCRC component of the study.

The sample for the present analyses was derived from two groups. The first group included parents who had children with childhood-onset DDs (e.g. attention deficit disorder (ADD)/attention deficit hyperactivity disorder (ADHD), learning disabilities, autism, cerebral palsy, epilepsy, Down syndrome, intellectual disabilities, and brain injury). A total of 163 respondents who completed both the phone interview and the mail survey of MIDUS II self-identified as having a child with one of the conditions listed earlier. Among these parents, 44 (27%) participated in the GCRC component of the MIDUS II. Of these 44 respondents, six were excluded from the present analysis because of missing values or extreme value of a biomarker. Therefore, the final analytic sample included 38 respondents who had children with DD. These 38 sample members did not differ from the entire group of parents of children with DD in the MIDUS II main survey ( $n = 163$ ) with respect to age, gender, education, household income, marital status, positive affect, or negative affect.

The comparison group comprises parents whose children did not have DD, nor did the parents have caregiving responsibilities for other family members at the time of the survey. We used stratified random sampling to select a

matched comparison group with gender, age, and education as stratification variables. As a result, 38 parents constituted the comparison group.

The two groups did not differ significantly with respect to the matching variables, household income, positive and negative affects, health behaviors (i.e. smoking), or the use of antihypertensive, cholesterol-lowering, steroidal drugs, or antidepressant medications.

## Measures

**AL.** AL is described as “the cumulative physiological toll (i.e. the extent of dysregulation) across multiple systems over time” (Seeman et al., 2010: 226). The measurement of AL is evolving as researchers formulate composite indices using various algorithmic and statistical techniques (Juster et al., 2009). For our study, to measure the cumulative physiological impact of difficult parenting demands, the levels of eleven biomarkers were combined to create a composite index. This AL index included four cardiovascular markers (systolic blood pressure, diastolic blood pressure, high-density lipoprotein (HDL) cholesterol, and total-to-HDL cholesterol ratio); a marker of glucoregulation (glycosylated hemoglobin) and central obesity (waist-to-hip ratio); four neuroendocrine markers (urinary cortisol, norepinephrine, epinephrine, and serum DHEA); and one acute phase marker of inflammation (C-reactive protein (CRP)). This diagnostic test was performed on a 12-hour urine sample and fasting blood sample, or obtained by physical exam from nurses, and completed during the respondent’s overnight stay. Urinary cortisol, norepinephrine, and epinephrine were adjusted to urinary creatinine level to control for partial voids and differences in urine volume given the 12-hour collection period.

First, the top quartile level was identified as the high-risk cut-off point (1 = high risk, 0 = not high risk) for nine of the measures, whereas the lower quartile was used for HDL and DHEA (given that higher HDL and DHEA are

desirable). Next, the 11 dichotomous risk variables were summed to create an overall indicator of AL, an approach based on previous research (Juster et al., 2009; Seeman et al., 2010).

**Positive affect.** Positive affect was assessed via the high positive affect scale in the Mood and Anxiety Symptoms Questionnaire (MASQ) (Watson et al., 1995). The scale consists of 14 items asking to what extent the respondent felt the following ways or had the following experiences during the past week: felt cheerful, optimistic, really happy, really up or lively, hopeful about the future, really good about oneself, like one was having a lot of fun; had a lot of energy; had accomplished a lot; was proud of oneself; looked forward with enjoyment; had a lot of interesting things to do; had a lot to look forward to; and seemed to move quickly and easily ( $\alpha = .93$ ).

**Negative affect.** Although our main interest was in the buffering effect of positive affect, we controlled for negative affect in our models in order to ensure that the effect of positive affect was independent from the absence of negative affect. Negative affect was measured by 12 items from the general distress–depressive symptoms scale in the MASQ (Watson et al., 1995) ( $\alpha = .90$ ).

Although the positive and negative affect items in MASQ assessed the respondent’s experiences *during the past week*, the responses were significantly correlated ( $p < .001$ ) with the levels of the positive and negative affects in the main surveys conducted at MIDUS I and II, which measured the respondent’s positive and negative affects *during the past 30 days* and were administered approximately 28 months (MIDUS II) and 12 years (MIDUS I) earlier than MASQ; these associations provide evidence of the stability of respondents’ affect levels over time.

**Covariates.** Prior research showed that older adults tend to evidence a higher AL than

younger adults and men tend to have higher AL than women (Juster et al., 2009). Thus, we controlled for the influence of age and gender. Additionally, we included dichotomous control variables for the use of antihypertensive and antidepressant prescription medications that might influence individual items in the total AL score. Smoking is controlled because it is also linked to cardiovascular and cancer morbidity and mortality (White, 2007). We also included the level of negative affect in the analysis to control the potential interdependency of positive and negative affects (Pressman and Cohen, 2005).

### Statistical analyses

Multiple regression analysis was used to examine the effect of parent status on AL and to determine whether positive affect moderated this relationship. First, we examined the effect of positive affect in a three-step regression analysis. The first step included demographic variables (age, gender, and education), medication variables, health behavior (smoking), and the level of negative affect. In the second step, parent status (parenting children with DD versus control) and level of positive affect were added to the model as main effects. In the last step, a variable measuring the interaction between parenting status and positive affect was added to the model. To analyze the significance of interactions post hoc, we conducted simple slope tests for the regression of the positive affect on AL for each parent group based on Aiken and West's (1991) approach.

### Results

Table 1 presents descriptive statistics for the two groups of parents. On average, the parents were in their mid-50s and had completed about 2 years of college education. Less than 25 percent were taking antihypertensive medication and about 16 percent were taking antidepressant medication. Of the parents of children with DD, 21 percent were smoking at the time of the

study, as compared to 11 percent of their comparison counterparts, but this difference was not statistically significant. The composite score for AL was 2.84 for parents who had children with DD and 2.58 for the comparison group parents. At the time of the survey, the children with DD were about 25 years old, and the duration of time since their condition was first apparent was about 22 years, on average.

Table 2 presents the results of the regression analysis examining the effects of parent status and level of positive affect on parents' AL. The results of step 1 indicate that both age and gender were significant predictors of AL, consistent with past research. Older parents exhibited higher AL than their younger counterparts, and fathers had higher AL than mothers. In step 2, parenting status and positive affect were added to the model as main effects, but neither significantly predicted AL. Thus, Hypothesis 1, predicting that parents of children with DD would have elevated AL, was not supported. Step 3 results, however, revealed a significant parenting status  $\times$  positive affect interaction, as predicted by Hypothesis 2. As illustrated in Figure 1, among parents of children with DD, those who reported lower levels of positive affect had significantly higher AL scores compared to those who reported greater levels of positive affect (simple slope test:  $b = -.079, p < .05$ ). In contrast, AL did not significantly vary contingent on positive affect among the comparison group parents.

### Discussion

The purpose of the current study was to examine the effects of parenting children with DD on cumulative biological risks, as measured by AL, while determining the potential moderating effects of positive affect on these associations. The results revealed evidence of important intragroup variation among parents of children with DD. Mothers and fathers who reported more positive affect had lower levels of biological risk than those with less positive affect. However, the level of AL of the parents of

**Table 1.** Descriptive statistics of parent participants (N = 76).

	Parents of children with DD (N = 38)	Comparison group parents (N = 38)	Range
	M (SD)	M (SD)	
Age	55.05 (11.16)	55.16 (11.10)	36–83
Education (years)	14.62 (2.45)	14.74 (2.56)	10.5–20
Negative affect	19.57 (6.33)	18.76 (7.36)	12–53
Positive affect	42.32 (9.56)	46.11 (9.24)	18–65
Age of children with DD	25.11 (11.25)	—	6–49
Age of onset of child’s DD	3.96 (4.89)	—	0–16
Duration of the child’s DD	22.04 (14.46)	—	2–49
Allostatic Load	2.84 (1.98)	2.58 (2.07)	0–7
	%	%	
Women	60.5	60.5	
Antihypertensive medication	23.7	21.1	
Antidepressant medication	15.8	15.8	
Currently smoking	21.1	10.5	

DD: developmental disorders; SD: standard deviation.

**Table 2.** Unstandardized regression coefficients for parenting children with developmental disorders, positive affect, and allostatic load of parents.

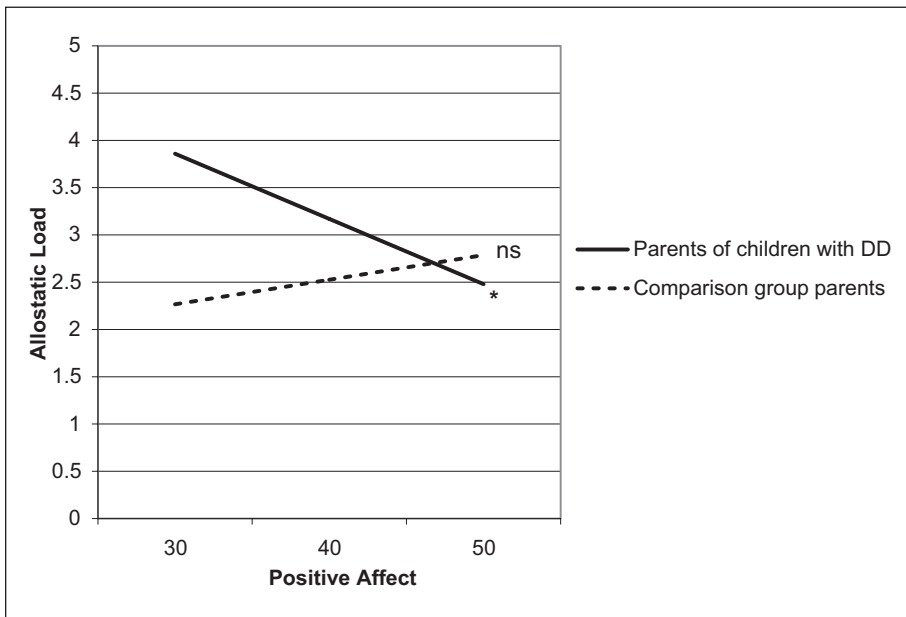
	Step 1		Step 2		Step 3	
	b	SE	b	SE	b	SE
Age	.073***	.020	.073***	.020	.075***	.019
Gender (1 = women)	-.976*	.444	-.924*	.450	-1.085*	.444
Education	-.048	.087	-.040	.088	-.041	.086
Negative affect	-.040	.035	-.068	.044	-.060	.043
Antihypertensive medications	.564	.557	.609	.564	.970+	.573
Antidepressant medications	-.528	.638	-.537	.643	-.462	.626
Current smoking (1 = yes)	.864	.629	.691	.652	.614	.635
Positive affect			-.033	.032	.025	.041
Parenting children with DD (1 = yes)			.109	.434	.122	.422
Parenting children with DD × positive affect					-.104*	.048
Constant	3.122		3.055		2.967	
R <sup>2</sup>	.262		.276		.325	

DD: developmental disorder. SE: standard error

+p < .10. \*p < .05. \*\*p < .01. \*\*\*p < .001.

children without DD did not differ contingent on the levels of positive affect. This pattern is consistent with previous studies showing more salient health benefits of positive psychological

resources among disadvantaged individuals than their counterparts. For example, Morozink et al. (2010) also demonstrated that the health benefits of both hedonic and eudaimonic



**Figure 1.** Predicted allostatic load scores by positive affect levels for parents of children with developmental disorders and comparison group parents. DD: developmental disorders; ns: not significant. \*  $p < .05$ .

psychological resources, such as positive affect, environmental mastery, purpose in life, and self-acceptance, were more evident among individuals with lower education. Chen et al. (2012) found that shift-and-persist strategies were associated with lower levels of AL among adults who grew up in low SES circumstances, but there was no benefit of resilience (as measured by shift-and-persist) among adults from a higher childhood SES background. Our results provide additional evidence that the health benefits of positive psychological resources are more salient among individuals with certain types of disadvantages or life challenges, rather than those without such challenging environments. It is also important to note the robustness of the current study's finding because a significant interaction between parent status and positive affect was found despite the small sample size (and lower statistical power to detect associations).

The prior research demonstrating significant beneficial effects of positive psychological resources also focused on several of the physiological systems assessed in the current study—cardiovascular and gluoregulation—as well as on proinflammatory cytokines, including interleukin-6, which is highly correlated with CRP, which we measured, and also AL (Chen et al., 2011, 2012; Morozink et al., 2010; Tsenkova et al., 2007, 2008).

Moreover, the benefits of positive affect for parents of children with DD remained significant even after controlling for the potential influence of negative affect. Thus, the health-protective effect of positive affect was not solely a reflection of lower negative affect. Our conclusion is congruent with studies that have shown associations between higher levels of positive affect and reduced health risk, independent of negative affect status (Steptoe et al., 2009). Considering the clinical implications of

these findings, it is possible that the risk for poor health among parents of children with DD would be attenuated by psychological interventions aimed at boosting positive affect.

The stress-buffering model of positive affect suggests several pathways through which positive affect may be associated with physical health in the face of parenting challenges. First, positive affect might influence stress appraisal and an individual's capacity to cope with stressors by promoting psychological resources such as resilience and optimism. For example, positive affect has been shown to enhance creative problem solving, which may help resolve stressors more quickly and consequently increase health protection (Ashby et al., 1999). Second, positive affect may promote restorative behaviors such as sleep, exercise, and relaxation, which reduce negative stress appraisal and negative affective responses to stress (Smith and Baum, 2003). As reported in Boehm and Kubzansky's (2012) review, positive affect is also associated with desirable health behaviors such as less smoking, less alcohol consumption, and healthy food consumption, which would result in better health outcomes. In addition, positive affect can facilitate physiologic recovery following the activation of stress-related physiology (Pressman and Cohen, 2005), for example, by influencing the release of endogenous opioids that act on autonomic and endocrine system responses triggered by stress or directly speeding up the recovery back to normative levels following a transient activation (Smith and Baum, 2003). Future research is needed to probe which of these mechanisms accounts for the stress-buffering effects of positive affect among parents of children with DD.

Our findings revealed that on average, the average AL values did not differ significantly between the parents of children with DD and the comparison group of parents raising children without disabilities. In part, the absence of an overall difference may be due to the strong influence of the parent's age, which was also significantly linked to the duration of the child's condition and consequently the duration of

parental caregiving. Previous research showed that the detrimental health effects of parenting children with DD were not manifested until parents reached their mid-60s and had experienced caregiving for several decades (Seltzer et al., 2011). The present sample included some parents as young as their mid-30s, so additional research on AL is still needed on older population of care providers for adult offspring with DD. It is possible that a larger sample of older care providers may have permitted us to detect a more pronounced overall difference in AL between the parents of children with DD and the control parents.

Some limitations of this study should be acknowledged. As noted, the small sample size in the current study could raise concerns regarding a Type II error. Although the present study is a first step in this line of research, testing models with a larger number of cases, especially among older parents, may better address the implications of a stress-induced physiological dysregulation for clinical disease. In addition, the children with DD had a heterogeneous range of conditions, which varied in their degree of challenge. Yet, the onset of these disorders was when the child was very young, and thus, the life course of the parents might have been similarly affected, at least to some extent. Furthermore, due to the limitations of using secondary data from MIDUS project, we did not have more detailed measures on children's characteristics, such as extent of behavior problems, although empirical evidence has shown that the severity of the child's behavior problems impacts parents' cortisol levels (Seltzer et al., 2010) and potentially other stress-sensitive biomarkers. Future research focused on specific conditions and characteristics of children (such as level of behavior problems) may reveal between-diagnostic group differences as well as a moderating influence of the children's characteristics on the parent's health. Finally, all the data analyzed in this study were collected at the same point in time, so questions about the direction of effects remain to be addressed in future research. Although we modeled the effects of



positive affect on AL, based on theoretical and empirical factors, and the fact that positive affect was stable over time (correlation between positive affect in the current study and 28 months earlier was .601 and the correlation over a 10-year period was .415), the results should be interpreted with caution given the cross-sectional nature of the data.

In conclusion, although the sample in the present study was relatively small, we took advantage of extensive biological data collected by the MIDUS study to evaluate parents of children with DD, who were part of a nationally representative sample. The overall results provide suggestive evidence for the beneficial health effects of positive affect for parents of children with DD, findings that should be followed up in future research. The findings emphasize the potential value of employing interventions that promote positive affect and outlook, especially for sustaining the capacity to bear up to challenging and persistent life stress such as demanding parenting. In future research, there is a need to investigate factors and pathways that allow parents of children with DD to maintain and enhance positive affect and consequently attenuate the physiological and health risks associated with long-term caregiving.

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