

# Daily Reports of Stress, Mood, and Physical Health in Middle Childhood

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**Abstract** Most empirical work examining stress in children focuses on major life events, like divorce of parents, while fewer studies consider the role of daily stressors, or the routine challenges of day-to-day living. Existing work on children's daily stress is lacking such that it primarily: (1) focuses on children who are ill, disabled, or who face significant environmental risks, (2) relies on retrospective reports, (3) relies on parent or teacher reports of stressors experienced by children, or (4) does not comprehensively examine the role of stress on mood and health. In the current study, we explored daily experiences of stress, mood, and physical health symptoms across five consecutive days in 25 children between 8 and 10 years old. Results showed that children reported a variety of types of stressors, and that more stressors were reported by older children, girls, and on weekdays compared to weekends. Daily reports of stress were linked to same day reports of physical health symptoms but not mood, however the presence of both negative mood and daily stress was associated with even more same day health symptoms. This study extends prior work by examining children's stress at the daily level as well as relying on children's self-reports of their stress, mood, and physical health symptoms.

**Keywords** Children · Stress · Health · Mood · Daily diary

## Introduction

Understanding stress experiences in children is critical. This includes examination of both *stressors*, defined by stress researchers as events or triggers that require the utilization of resources or adaptation (e.g., Halbesleben et al. 2014) and *stress*, the emotional and/or physical response of an individual to a stressor (e.g., Almeida 2005). First, despite that childhood has traditionally been conceptualized as a stress-free time, literature indicates that children not only experience stressors (e.g., Byrne et al. 2011; Lau 2002; Lehman and Repetti 2007), but that the prevalence of childhood stress is high (e.g., American Psychological Association 2012; Vanaelst et al. 2012). Secondly, children are particularly vulnerable to stressors, and more current research indicates that that stress can have a major influence on their psychological and physical health status (e.g., Grant et al. 2003; Hostinar and Gunnar 2013; Miller et al. 2011).

Most studies examining stress experiences in children have considered major life events, like divorce of parents, economic adversity, trauma exposure, or death of a family member (Lau 2002; Thompson 2014; Vanaelst et al. 2012) as significant sources or triggers for negative psychological and physical health consequences. Such tradition of inquiry ignores the role of daily stressors in children's lives. As Lau (2002) stated, "...it is easy to forget or ignore the many school pressures and increasingly common social phenomenon of the 'hurried child' in modern life" (p. 238). Additionally, given that major life events in general are relatively rare, and their cumulative effect on health and well-being

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may not be as great as that of minor yet frequent stressors (Almeida 2005; Lazarus 2006; Zautra 2003), a consideration of children's daily stressful experiences is important. Daily stressors are the routine challenges of day-to-day living, and though they are considered to be relatively minor or routine, they tend to have more proximal effects on well-being than do major life events (Almeida 2005). Indeed, "daily stressors exert their influence through separate and immediate direct effects on emotional and physical functioning, and by piling up over a series of days to create persistent irritations, frustrations, and overloads that increase the risk of serious stress reactions, such as anxiety and depression" (Almeida et al. 2011, p. 192). Over the last 20 years, there has been tremendous research efforts examining daily stressors among adults, but relatively less is known about stressor experiences among children.

In adults, daily stressors, such as conflict, everyday concerns of work, and commuting between work and home, have been shown to influence mood, sense of well-being, behavior and health (Almeida 2005). Research has indicated that adults report experiencing stressors most often in the domains of interpersonal, home, work, and network (stressors that happen to close friends or family members; Almeida and Horn 2004). It has also been shown that males and females experience daily stressors differently; for example, women are more likely than men to report experiencing network stressors, while men are more likely to report stressors related to work (Almeida 2005). Interestingly too, research has indicated that not all stressors are created equally, such that some stressors are unhealthier than others (Almeida and Horn 2004), and certain stressors such as marital tensions, are more likely to occur on weekends, while other stressors such as home overloads and family demands are more prevalent on weekdays (Almeida et al. 1999). A consideration of stressor type, as well as gender and temporal patterns of stressor experiences, provides greater insight into the complex nature of stress. While we understand a great deal about such experiences in adults, we know relatively little about stressor experiences among children. Given that children's experiences of daily stress are likely to be quite different than adults, it is critical we better understand the magnitude of stressor exposure in childhood and its impact on children's daily well-being.

Previous examinations of children's daily stressful events have relied primarily on retrospective reporting of daily stressors among the past week, month, or even year which can lead to response biases and concerns regarding validity of self-reported outcomes (Bailey and Garralda 1990; Byrne et al. 2011; Vanaelst et al. 2012). These retrospective accounts may also fail to capture nuanced and short-term responses that children have to commonly occurring daily stressors, such as arguing with friends or being late to

school (Lehman and Repetti 2007; Repetti et al. 1999). To reduce this potential response bias and inaccurate reporting due to time and to gain a better understanding of the stress experiences in children in general, it is important to capture daily assessments of children's experiences. However, little work has examined children's daily experiences of stress.

Most stressor studies among children have also relied solely on parent and/or teacher reports of stressors experienced by children, though research has shown that children are capable of identifying daily events and activities that are distressing or upsetting to them (Banez and Compas 1990; Muldoon 2003). Children's perceptions of stressful events continue to be a much-neglected area of inquiry, with ongoing reliance on adults' ratings, despite the fact that adults' ratings of the stressors experienced by children do not necessarily concur with children's own ratings. In fact, adults tend to underestimate the level of stress that children associate with negative events (Muldoon 2003), which may be due to the fact that parents have limited awareness of the daily hassles and challenges children experience and likely judge the perceived stressfulness of events differently or less than stressful as compared to children (Vanaelst et al. 2012). On the other hand, given that parents are often involved in or play a role in the stress that children experience, parents may also over report the impact of some events in which they are emotionally involved (Bailey and Garralda 1990). In either circumstance, parents indeed may serve as less reliable informants or judges of their children's stress experiences. Obtaining children's direct reports of events *they* perceive as stressful is critical given that such perception may significantly influence their behavior, how well they adjust or adapt to stressors (Muldoon 2003; Vanaelst et al. 2012), and the overall impact of the stressful event (Muldoon 2003). Indeed, several researchers argue that researching children's lived experiences, as relayed from their points of view, is critical to ensuring their voices are heard and understood and are essential to developing effective interventions (Alerby 2000; Kostenius and Öhrling 2008; Lindsay and Lewis 2000).

In addition to the aforementioned limitations, the majority of studies examining stress in children have focused on children who are ill, such as those with asthma, OCD and Tourette's Syndrome, are handicapped, face socioeconomic and health risk, or are children with psychological vulnerabilities, such as mood and adjustment disorders (Connelly and Bickel 2011; Hema et al. 2009; Walker et al. 2001). Such studies may have limited relevance to the broader assessment of stress in children. Moreover, few scales have been developed specifically for typically developing children.

A comprehensive model of stress in any age group needs to take into account the impact of stress. Given that

researchers have documented a strong association between daily stress exposure and poor health and psychological outcomes in adults, we also examined children's self-reports of co-occurring daily physical health symptoms and mood. Not surprising, previous research examining the relation of daily stressors to somatic and emotional symptoms among youth are heavily limited to clinical samples (e.g., children with recurrent abdominal pain, teens with Sickle Cell Disease) or reliance on parental reports of children's experiences (Gil et al. 2003; Walker et al. 2001). Though outdated, Banez and Compas (1990) did find that children's self-reports of depressive symptoms were associated with children's daily stressors, although reports were obtained for one timepoint during their study. More current research that utilized daily report approaches found that negative school events were associated with changes in mood and interactions with parents (Lehman and Repetti 2007). Unfortunately, such studies neglected to assess for stressors occurring outside of school (such as afterschool activities or at home), and did not include physical health symptoms, salient components to capturing a more comprehensive portrait of children's daily lives.

The present study uses daily diary methodology to address two primary study aims. Our first goal is to describe children's daily reports of stress, mood, and physical health symptoms, including differences by age, gender and day of the week. Our second goal is to describe associations among children's daily reports of stress, mood, and physical health symptoms, as well as interactions between stress and mood in predicting daily health symptoms.

## Method

### Participants

Twenty-five children between the ages of eight and ten ( $M_{\text{age}} = 9.6$  years,  $SD = 0.87$ ) participated in the current study. Participants were recruited through fliers and teacher request from the second, third, and fourth grades in a private religious-based school located in a suburban city in Southern California. Families would have been excluded if the child did not speak English or had an Individualized Education Plan due to special needs. However, neither of these exclusion criteria applied to the study volunteers. Although families were recruited from a private school, there was still diversity within the sample. SES ranged from less than \$30,000 to over \$100,000 with 40% of the sample earning less than \$75,000. Less than half of the participants were Caucasian (44%); specifically, 28% of children were Hispanic or Latino and another 20% reported being of mixed ethnicity. Most parents were married (84%) and

household size ranged from 2 to 7 people, with almost half of the children (48%) living in a four-person household.

### Procedure

Consent and assent forms were completed with the parents and children at the children's school during an initial start-up meeting. Children were told that our research team was interested in talking with them about what "goes on in their life" and that "sometimes we all experience things that causes frustration or challenges, or even excitement" and that we wanted to learn more about this. Children were also told that they did not have to answer anything that made them feel uncomfortable, that they could tell us if they did not want to talk or share, and that they could drop out of the study at any time. All of this was explained to parents as well at this time. During this same meeting, a research assistant explained the daily diary procedure to the participants and talked to the mothers individually about their daily schedules to determine the optimal time for daily interviews. Children were interviewed daily for 5 days beginning on Thursday and ending on Monday. Interviews were conducted over the phone between 5 pm and 8 pm by a research assistant. Children were asked to complete their interviews away from other family members so that they could speak freely.

### Measures

A structured interview was used to measure the daily experience of stressors as well as physical health symptoms and mood. Every day, children were asked to think back since the last time they had talked to the researcher or, if it was the first interview, since about that same time the night before.

#### *Stress experiences*

To assess daily stress experiences, we used the Daily Diary Interview, which has been used previously with similarly aged children (see Walker et al. 2001 for information about development and validation of this measure). Children were asked whether or not they experienced a list of 24 stressors that children their age are likely to experience (see Table 1 for a list of the stressors). Children were asked individually about each stressor and responded "yes" or "no" to whether or not they experienced each stressor on that particular day. A sum score was created to represent the total number of stressors the child reported each day. In order to examine nuances in children's reports of stress, we also categorized the list of stressors into five sub-groups. Five sub-groups were created and each included between three and six individual items (see Table 1). The Interpersonal category

**Table 1** Stressors listed in the daily diary interview

Daily stressors by category	Mean (SD)
Perceptions of control	1.4 (1.0)
1. Misplacing or losing things	
2. Having to wait for someone or something	
3. Not getting something you want	
<b>4. Getting parents to take you to and from school, friend's homes, or other places</b>	
5. Losing a privilege, like playing video games or watching TV	
Wellness	1.0 (0.9)
6. Being sick	
7. Going to the doctor or dentist or taking medicine, or some other health related activity	
<b>8. Not getting enough sleep or feeling tired or worn out</b>	
9. Having nightmares or bad dreams	
Interpersonal	1.6 (1.4)
10. Someone interrupts you while you are doing something else	
<b>11. Someone bothering or annoying you</b>	
12. Trying to get along with other kids in your class or on your team	
13. Unable to talk to other people about your thoughts or feelings	
14. Not being liked or teased or someone was talking about you	
15. Having a misunderstanding or disagreement with someone	
Time management	0.7 (0.9)
16. Not enough time for fun things or time to play	
17. Too many things to do	
<b>18. Not enough time to get everything done</b>	
Performance related	2.0 (1.3)
19. Competing or performing in something	
20. Thinking about the way you look	
<b>21. Something is too easy or boring</b>	
22. Feeling like you could not do your best	
23. Doing something new or hard, like at school or sports or music, etc	
24. Getting grades back on your school work	

*Note.* From the Daily Diary Interview (Walker et al. 2001). Bolded items represent most commonly reported stressor within that category. Mean represents average number of stressors reported each day for each stressor category

was made up of six items that involved stress related to interactions with other people (e.g., “*having a misunderstanding or disagreement with someone*”). Perceptions of Control included five items that involved children feeling like they may not have control over a situation (e.g., “*not getting what you want*”). The Performance Related category included six items that involved the child performing or

presenting themselves (e.g., “*getting your school grades back*”). Time Management was composed of three items that related to children managing their time throughout a given day (e.g., “*too many things to do*”). Finally, Wellness included three items that related to physical or emotional well-being (e.g., “*going to the doctor*”).

### Health symptoms

To assess physical health symptoms, we adopted the protocol of the National Study of Daily Experiences (NSDE; Almeida et al. 2002) that used a shortened version of Larsen and Kasimatis' (1991) physical symptoms checklist. The scale assessed symptoms including gastro-intestinal (e.g., stomachache), cold and flu (e.g., runny nose), muscular (e.g., sore neck), and neurological (e.g., trembling or shaking) health symptoms. The only changes that were made to this checklist was to remove “cold or hot flashes” as this was not relevant to children. Children responded “yes” or “no” to whether or not they experienced the health symptom that day. Sum scores were created for each of these physical health categories for each day. Included in the list of physical health symptoms was whether or not the child had felt low energy or tired. This item was analyzed on its own rather than as part of a category.

### Daily mood

Children were presented with four positive and negative emotions and rated each on a 3-point scale regarding the extent to which they experienced that emotion throughout the day (0 = “*none of the time*”, 1 = “*some of the time*”, 2 = “*all of the time*”). The list of positive emotions included “*happy*”, “*enjoyment*”, “*joyful*”, and “*fun*”, while the negative emotions included “*sad*”, “*angry*”, “*frustrated*”, and “*worried*”. Children were asked how often (i.e., none of the time, some of the time, or all of the time) they experienced a list of positive emotions (e.g., happy, enjoyment) and negative emotions (e.g., sad, worried, angry). A sum score for both negative emotions and positive emotions was then calculated for each day. Cronbach's alpha reliability scores were .62 for positive emotion and .78 for negative emotion.

### Data Analyses

We first computed descriptive statistics on children's stress using frequencies and mean scores, as well as *t*-tests and bivariate correlations to examine associations by child age and gender. We then examined compared frequency of stress on weekdays compared to weekends using paired sample *t*-tests. In addition to exploring individual stressors, we also categorized the stressors and examined the average number of stressors per day that children reported in each

category. To account for the different number of stressors in each group, we also examined the percentage of items reported within each category. Following the section on children's stress, we examined children's daily mood and then children's health symptoms using the same analysis strategy.

In the next section, we examined associations between children's reports of stress, mood, and health in two ways. We first examined general associations among the three study constructs by aggregating the scores by child across the week, and examining correlations among these aggregated reports. The stress and health variables represent the total number of times the event was reported across the 5 days, while the mood scores represent the average score on the positive and negative mood items for the study period.

We then examined associations among children's reports of stress, mood, and health at the daily level, using multi-level linear regression. We specified a two-level model such that the five daily reports (Level 1) were nested within children (Level 2). All models used Maximum Likelihood Estimation and autoregressive covariance structure to account for correlated errors. Child age and gender were added as Level 2 covariates, and time was included as a Level 1 covariate to account for changes in reporting associated with the number of days in the study. In order to allow for accurate interpretation of the estimates in the multilevel model and to focus on within-person variation, all predictors were centered on the individual level mean. The time variable was centered such that a value of zero represented the third day in the study. Because not all models achieved convergence with random slopes, all models were specified as random intercepts, fixed slope models to maintain consistency.

In our final set of analyses, we explored directional relationships among our constructs by examining lagged effects (Larson and Almeida 1999; West and Hepworth 1991). We specified three separate multilevel regression models predicting health symptoms from the previous day's stress, positive mood, and negative mood reports. By controlling for the previous day's health symptoms, we could predict change in health symptoms across study days. For these models, the random intercepts model did not achieve convergence, so a fixed slopes, fixed intercepts model was specified.

## Results

Before evaluating the primary study aims, we examined relationships between demographic variables and our primary study variables. Child age was positively related to both average number of daily stressors reported ( $r = .46$ ,

$p = .02$ ), and average number of aches and pains reported ( $r = .41$ ,  $p = .05$ ), such that older children tended to report more than younger children. In terms of stress categories, older children were more likely to report performance related stressors, ( $r = .44$ ,  $p = .03$ ) than younger children. Examining gender, on average girls ( $M = 7.6$ ,  $SD = 2.0$ ) reported more stressors than boys ( $M = 5.5$ ,  $SD = 2.4$ ). Specifically, girls reported more wellness, time management, and interpersonal stress than boys. No other significant relationships emerged from the demographic data (SES, parent education level, race/ethnicity).

## Children's Daily Experiences of Stress, Mood and Health Symptoms

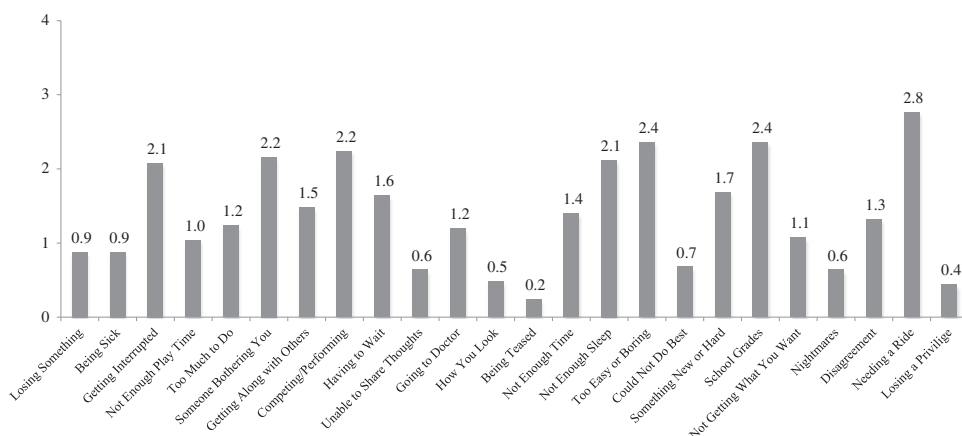
### *Daily reports of stress*

The first goal of the current study was to explore and describe children's daily experiences of stress. Based on five daily reports of the 24-item measure, children could report up to 120 total stressors for the study period. Over the course of the 5-day study period, children reported between 7 and 55 total stressors with an average of 33.0 stressful events reported ( $SD = 12.2$ ). Per day, out of 24 stressful events children reported between 0 and 16 stressors, with an average report of 6.6 stressors ( $SD = 2.4$ ) per day. Of the 25 children in the sample, two children (8%) reported an average of more than 10 stressors per day, while two children reported less than 2 stressors per day on average.

Looking at individual items, the most commonly endorsed stressor was "needing a ride from parents" which was reported by 13.8 (55.2%) kids per day, on average. The two other most commonly endorsed stressors were "finding something too easy or boring", and "getting school grades back", which were both reported by 11.8 (47.4%) children per day on average. "Being teased" was the least endorsed stressor, reported by an average of 1.2 (4.8%) kids per day. Further, "losing a privilege" and "thinking about how you look" were uncommonly endorsed as well, reported by less than 10% of children per day (8.8 and 9.6%, respectively). Figure 1 shows the average number of days that children reported each individual stressor.

When examining children's stressors by category, children most commonly endorsed performance-related stressors, reporting an average of 2.0 stressors per day out of six total items (33%), and stressors related to perceptions of control, with an average of 1.4 stressors per day (28% of 5 items). Interpersonal related stress was also common, with children reporting an average of 1.6 interpersonal stressors per day (26% of six items). Less common were time management and wellness stressors, with children reporting less than one stressor in each category per day. However, these groups were also smaller and on average children reported

**Fig. 1** Average number of days stressor reported by individual children



25% of the three items in the time management group and 24% of the four items in the wellness category. Complete means and standard deviations for each category are reported in Table 1.

Next, we examined whether the number of daily stressors differed based on the day of the week. Results of a paired samples *t*-test revealed that children reported significantly more individual stressors on weekdays compared to weekend days,  $t(24) = 5.46$ ,  $p < .001$ . On average, children reported 7.5 stressors ( $SD = 2.7$ ) on weekdays and 5.2 stressors ( $SD = 2.6$ ) on weekend days. The highest frequency of stressors was reported on Thursday ( $M = 9.8$ ,  $SD = 2.8$ ) while the least number of stressful events were reported on Saturday ( $M = 5.26$ ,  $SD = 2.9$ ). The types of stressors children reported also varied on weekdays compared to weekends. On weekdays, children reported significantly more performance-related stressors (weekday  $M = 2.7$ ,  $SD = 1.0$ ; weekend  $M = 1.5$ ,  $SD = 0.9$ ) and stressors related to perceptions of control (weekday  $M = 1.5$ ,  $SD = 0.7$ ; weekend  $M = 1.1$ ,  $SD = 0.8$ ).

#### Daily reports of mood

The present study also sought to explore children's daily experiences of positive and negative mood. Across all five study days, children reported a mean positive mood score of 1.3 ( $SD = 0.4$ ), with a minimum score of 0.7 and a maximum of 2.0. The mean negative mood score was 0.44 ( $SD = 0.36$ ), with a minimum score of 0.10 and a maximum score of 1.10. Among the four positive emotions, children reported the highest scores for enjoyment,  $M = 1.38$ ,  $SD = 0.45$ , and the lowest for feeling pleased,  $M = 1.1$ ,  $SD = 0.49$ . For negative emotions, children reported the most frustration,  $M = 0.59$ ,  $SD = 0.34$ , and the least worry,  $M = 0.35$ ,  $SD = 0.32$ . All 25 children reported feeling happy at least some of the time every day and the majority of kids (72 to 88%) reported experiencing the other three positive emotions at least some of the time every day. Very few

children, only 4% ( $n = 1$ ) to 16% ( $n = 4$ ) reported feeling negative emotions on all 5 days.

Next, we examined differences in mood by day of the week. Results of a paired samples *t*-test revealed no difference between positive mood scores on weekdays compared to weekend days,  $t(24) = 1.64$ ,  $p = .11$ . However, children reported significantly higher negative mood scores on weekdays,  $M = 1.96$ ,  $SD = 1.08$ , compared to weekends,  $M = 1.50$ ,  $SD = 1.38$ ;  $t(24) = 2.08$ ,  $p = .048$ . The highest negative mood score occurred on Thursday,  $M = 0.55$ ,  $SD = 0.32$  and the lowest on Sunday,  $M = 0.31$ ,  $SD = 0.38$ .

#### Daily reports of health symptoms

The second major goal of the present study was to describe children's daily reports of health symptoms. Of the 15 total health symptoms, children reported an average of 2.4 symptoms ( $SD = 1.6$ ) per day. Of the five categories of health symptoms (GI, neurological, cold symptoms, aches and pains, tired or low energy), children most often reported feeling tired ( $M = 2.5$  days) or experiencing aches and pains ( $M = 2.1$  days). Children experienced cold, GI, and neurological symptoms slightly less often, averaging 1.8, 1.7, and 1.4 days per child, respectively. Sixteen percent of children ( $n = 4$ ) reported feeling tired or fatigued on all 5 days of the study and the same amount of children reported aches and pains every day. Less than 10% of children reported neurological ( $n = 2$ ), GI ( $n = 2$ ), or cold symptoms ( $n = 1$ ) on all five study days. Most kids (75% or more) experienced each type of health symptom on at least 1 day, except for neurological symptoms in which 32% of kids did not report experiencing during the five study days.

Next, we examined differences in health symptomatology by day of the week. Results of a paired samples *t*-test revealed that children reported significantly more health symptoms on weekdays compared to weekend days,  $t(24) = 4.22$ ,  $p < .001$ . On average, children reported 2.8 health symptoms ( $SD = 1.8$ ) on weekdays and 1.8 symptoms

(SD = 1.5) on weekend days. Similar to daily stressors, children reported the most health symptoms on Thursday ( $M = 3.4$ ,  $SD = 2.3$ ) and the fewest on Saturday ( $M = 2.0$ ,  $SD = 1.6$ ).

**Associations between Children’s Daily Reports of Stress, Mood, and Health**

Table 2 presents correlations between weekly summaries of stress categories, health, and mood reports. Analyses showed that the number of overall stressful events children reported during the 5 days were positively related to the number of aches and pains,  $r = .41$ ,  $p = .04$ , and the number of times children reported having low energy or feeling tired,  $r = .67$ ,  $p < .001$ . Number of cold symptoms was positively correlated with stressors related to perceptions of control,  $r = .44$ ,  $p = .03$ . Not surprisingly, stressors related to wellness (i.e., “being sick”, “feeling tired”), were positively related to cold-related health symptoms,  $r = .40$ ,  $p = .047$ , and children’s reports of feeling tired or fatigued,  $r = 0.66$ ,  $p < .001$ ). Children’s reports of interpersonal stressors was positively correlated with negative mood,  $r = 0.51$ ,  $p = .01$ , feeling tired or fatigued,  $r = 0.51$ ,  $p = .01$ , and experiencing aches and pains,  $r = 0.44$ ,  $p = .03$ .

*Predicting daily mood*

We also explored the relations between stress and health in predicting daily mood. The null model for negative mood revealed that 22.7% of the variance in negative mood was explained by differences among children. The null model revealed no significant linear trend of time for reports of

negative mood, estimate =  $-0.13$ ,  $SE = 0.08$ ,  $t(32.6) = 1.51$ ,  $p = .14$ . The final model revealed a significant association between number of stressors reported and child negative mood, estimate =  $0.02$ ,  $SE = 0.01$ ,  $t(99.3) = 2.22$ ,  $p = .03$ , when controlling for time, age, and gender. However, when examining the association between stress and negative mood using the sub-groups of stress, we found that only children’s reports of stress related to perceptions of control were positively associated with same day negative mood, estimate =  $0.10$ ,  $SE = 0.03$ ,  $t(99.5) = 3.33$ ,  $p = .001$ .

The null model for positive mood revealed that 66.6% of the variance in positive mood was accounted for by differences among children and showed no significant linear trend of time for daily reports of positive mood, estimate =  $-0.07$ ,  $SE = 0.07$ ,  $t(37.0) = 1.03$ ,  $p = .31$ . Number of daily stressors did not emerge as a significant predictor of positive mood, estimate =  $-0.01$ ,  $SE = 0.01$ ,  $t(97.8) = -1.08$ ,  $p = .28$ .

*Predicting daily health symptoms*

Next we examined the associations between stress and mood in predicting daily health symptoms. The first step was to run a null model, with health symptoms as the dependent variable and time as the only predictor, in order to examine children’s trends of health symptoms across the study period. Model 1 revealed that 27.3% of the variance in health symptoms on day 3 was explained by differences among individual children. This model revealed a significant linear trend of time, such that children reported less daily health symptoms as the study progressed (see Table 3).

We ran separate models to examine the individual effects of stress, positive mood, and negative mood on daily health symptoms. Results revealed a significant association

**Table 2** Correlation matrix for weekly summaries

	1	2	3	4	5	6	7	8	9	10	11	12
1 Control	–											
2 Wellness	0.34	–										
3 Time Mgmt	0.05	–0.05	–									
4 Interpersonal	0.17	0.16	0.59**	–								
5 Performance	0.61**	0.53**	0.02	0.14	–							
6 Positive mood	0.05	0.02	–0.08	–0.32	0.18	–						
7 Negative mood	–0.14*	0.29	0.21	0.51*	–0.20	–0.43*	–					
8 Aches & Pains	0.18	0.09	0.33	0.44*	0.16	–0.00	0.13	–				
9 Neurological	–0.08	0.21	0.17	0.36	0.07	–0.07	0.53**	0.27	–			
10 Gastrointestinal	–0.02	0.33	0.14	0.29	0.17	0.21	0.50**	0.54**	0.60**	–		
11 Cold symptoms	–0.43*	0.40*	0.05	0.23	0.14	–0.22	0.47*	0.08	0.36	0.22	–	
12 Tired/Fatigue	0.39	0.66***	0.24	0.50*	0.31	–0.17	0.43*	0.45*	0.28	0.27	0.30	–
13 Child age	0.20	0.14	0.20	0.37	0.44*	0.06	0.04	0.41*	0.12	0.14	0.09	0.27

Note.  $N = 25$ ; \* $p < .05$  (2-tailed), \*\* $p < .01$  (2-tailed), \*\*\* $p < .001$  (2-tailed)

**Table 3** MLM estimates for stress and mood on daily health symptoms

	Estimate	SE	95% CI	−2 LL	df	$\chi^2$ diff.
Null model				472.21		
Intercept	2.52***	0.31	[1.88, 3.17]			
Time (Day)	−0.29*	0.12	[−0.53, −0.05]			
Level 2 covariates model				467.70	2	4.51*
Age	0.52	0.35	[−0.21, 1.24]			
Gender	−0.70	0.60	[−1.95, 0.54]			
Individual level 1 predictors <sup>a</sup>						
Daily stressors	0.28***	0.05	[0.19, 0.37]	435.69	1	32.01***
Perception of control	0.45**	0.17	[0.12, 0.78]	460.70	1	7.00**
Wellness	0.99***	0.17	[0.65, 1.33]	439.74	1	64.57***
Time management	0.29	0.16	[−0.02, 0.60]	464.39	1	3.31
Interpersonal	0.48***	0.13	[0.22, 0.75]	455.88	1	11.82***
Performance related	0.38***	0.12	[0.15, 0.61]	458.21	1	9.49**
Negative mood	1.22*	0.51	[0.19, 2.24]	462.60	1	5.10*
Positive mood	−1.06*	0.51	[−2.06, −0.05]	463.57	1	4.13*
Interaction models						
Negative mood × stress	0.40*	0.17	[0.06, 0.74]	428.65	2	7.04 <sup>b</sup>
Positive mood × stress	−0.01	0.19	[−0.38, 0.36]	432.06	2	3.63 <sup>b</sup>

<sup>a</sup> Each model ran individually including child age, gender, and time as covariates

<sup>b</sup> Compared to model including covariates and Daily Stressors

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

between stress and health such that for every additional stressor reported in a given day, children reported an average of 0.28 more health symptoms,  $SE = 0.05$ ,  $t(96.9) = 6.14$ ,  $p < .001$ . To examine more nuanced associations between stress and health, we tested the sub-groups of child-reported stressors in predicting daily health symptoms. Consistent with the overall measure of stress, all sub-groups were positively associated with children's reports of health symptoms except for stressors related to time management, estimate = 0.29,  $SE = 0.16$ ,  $t(85.2) = 1.84$ ,  $p = .07$  (see Table 3).

Mood was also a significant predictor of daily health symptoms, such that lower positive mood scores and higher negative mood scores were associated with more health symptoms (see Table 3). In a final set of models, we examined the interaction between mood and stress in predicting health symptoms. A significant interaction was found between negative mood and stress experiences, estimate = 0.40,  $SE = 0.17$ ,  $t(89.2) = 2.35$ ,  $p = .02$ , such that the link between daily stressors and health symptoms was stronger when children also reported above average levels of negative mood. Importantly, among our sub-groups of stress, this interaction was only present for stressors related to perceptions of control, estimate = 0.43,  $SE = 0.18$ ,  $t(91.1) = 2.44$ ,  $p = .02$ . No significant interaction with stress and positive mood emerged from the data, estimate = −0.01,  $SE = 0.19$ ,  $t(80.0) = −0.05$ ,  $p = .96$ .

### Exploratory lagged analyses

Given the daily diary design of the study, we were able to explore causal relationships among our constructs by examining lagged effects (Larson and Almeida 1999; West and Hepworth 1991). We only explore lagged models of health symptoms, given that the models predicting mood did not emerge as significant in the previous analyses. Results indicated that the previous day's stressful events predicted current day health symptoms, when controlling for the previous day's health symptoms, estimate = −0.21,  $SE = 0.06$ ,  $t(91.6) = −3.46$ ,  $p = .001$ . Interestingly, the negative direction was unexpected and suggested that higher reports of stressful events were associated with *less* health symptoms on the following day. For sub-groups of stress, this negative link between previous day's stress and next day health symptoms only emerged among stressors related to time management, estimate = −0.47,  $SE = 0.19$ ,  $t(67.5) = −2.53$ ,  $p = .01$ , and wellness, estimate = −0.61,  $SE = 0.23$ ,  $t(81.9) = −2.61$ ,  $p = .01$ . Neither previous day positive mood nor previous day negative mood were significant predictors of next day health symptoms, although the model fit statistics showed significant improvement over the models with covariates only. The full models are detailed in Table 4.



**Table 4** Exploratory lagged models for stress and mood on daily health symptoms

	Estimate	SE	95% CI	−2 LL	df	$\chi^2$ diff.
Covariates only model				421.76		
Intercept	1.19*	0.51	[0.12, 2.26]			
Time (Day)	−0.23*	0.11	[−0.45, −0.001]			
Age	0.29	0.24	[−0.22, 0.80]			
Gender	−0.39	0.41	[−1.26, 0.47]			
Previous day health	0.43***	0.08	[0.27, 0.58]			
Previous day predictors <sup>a</sup>						
Stressors	−0.21**	0.06	[−0.32, −0.09]	353.05	1	68.71***
Negative mood	0.13	0.75	[−1.37, 1.63]	364.31	1	57.45***
Positive mood	0.22	0.65	[−1.08, 1.53]	364.22	1	57.54***

<sup>a</sup> Each model ran individually including child age, gender, time, and previous day health symptoms as covariates

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

## Discussion

Given the high prevalence of stress in daily life and the negative outcomes commonly associated with it, it is advantageous to gain a more elaborate understanding of the role of stress in the lives of children. Building on previous work examining stress experiences in children (e.g, Bailey and Garralda 1990; Banez and Compas 1990; Gil et al. 2003; Muldoon 2003), the current study sought to explore the occurrence of stress experiences in the lives of typically developing children and the relationship between stress and daily reports of mood and health symptoms.

The first major goal of the study was to describe the daily experiences of stress, mood, and health symptoms over a five-day period. We found that when presented with a list of 24 possible stressful events, on average children report less than two stressors per day and most commonly reported being stressed about obtaining a ride from their parents, getting school grades back, or finding a task to be too easy. While these descriptive analyses were exploratory in nature, the findings revealed salient information about the experiences that children consider stressful as well as the frequency of stress and physical health symptoms in children’s daily lives. While many may think that childhood is a carefree time, with no worries or responsibilities, the present study sheds greater light on the fact that children do in fact experience stress, which is consistent with recent reports of high levels of stress in children (APA 2012).

The second goal of the study was to examine relationships among the daily reports of stress, mood, and health symptoms. We found that mood and stress were both related to higher reports of health symptoms on the same day. These findings are consistent with previous research that examined the associations between stress and health symptoms and stress and negative mood in adults and in children with chronic abdominal pain (Almeida 2005;

Walker et al. 2001) and extends these findings to typically developing children. We also found that when both negative mood and stressful events were high, children reported an even higher occurrence of health symptoms compared to days when they reported only increased stress or negative mood. There was not a moderating effect of positive mood on the association between stress and outcomes, suggesting that while negative mood seemed to exacerbate the effects of stress on health, positive emotion did not serve as a buffer. One interpretation of this combined effect is that when children have a more difficult time coping with their stress, exhibited as negative mood, there is a greater impact on their health. Although this interpretation is speculative, it suggests that there is immediate impact of daily stress on children’s mood and health, highlighting the need for promoting healthy coping strategies in children.

It is important to note that these relationships occurred within the same day, which prevents us from making causal claims about the findings. It could be that the health symptoms were the cause of the increased stress and negative mood, and not the other way around. To answer this question, we explored causality through lagged effect models and found that previous day stress reports were related to lower reports of health symptoms the following day, but the same effect was not present for mood. While no directional hypotheses were identified, we were surprised to find that stress was associated with less health symptoms the following day. Because stress was also related to same day health symptoms it may be that on the following day when children might be feeling less stressed, they also feel better physically. These results suggest that the negative impact of stress on health symptoms does not carry over to the next day, and children may even experience a rebound effect in which they feel even better physically than they did on the day when they felt more stress. This is particularly interesting, given that there has been evidence showing

carryover effects of stress for adults (Caspi et al. 1987; van Eck et al. 1998). This is an important link that has not previously been identified in self-reports of children's daily experiences thus highlighting the importance of studying the possible unique impact and resilience of stress in children.

Additionally, these findings extend prior work that has primarily examined clinical or at-risk samples of children (Connelly and Bickel 2011; Hema et al. 2009; Walker et al. 2001), and relied on retrospective or parent/teacher reports of children's stress. The current study affirms that children can communicate effectively about their daily stress experiences, but also presents salient insight into gathering information from children about their daily physical and emotional health experiences as well. It will be crucial to continue to give children a voice in future stress research especially given findings that children and the adults around them often differ in reports of children's stress experiences (APA 2012). Importantly, we found that children do experience daily stress and we were able to identify some of the ways in which they experience that stress. Further, the associations among children's stress and same day reports of mood and health implies that daily stress does have a negative impact on children, in ways that are both similar and different from adults. Given that children experience and react to stress differently than adults (Caspi et al. 1987; Repetti et al. 1999; van Eck et al. 1998), it is likely that children cope with daily stress in different ways as well. Gaining a more nuanced understanding of the way children experience stress, and the sources of their stress, can help us design interventions that are tailored specifically to children's stress experiences and promote adaptive coping skills.

The contributions of this study should be considered in light of its limitations. First, due to the fact that daily diary studies in children are rare, we did not have access to previously validated measures for assessing daily reports of stress in children. Our measure taps into 24 possible events that children may report as stressful, but does not leave an opportunity for children to report on other events they may have found stressful that were not included on this list. Further, the checklist method of assessing stress does not account for how stressful the children perceived those events. Future research should explore daily stressful events in children using open-ended formats to fully explore the perceptions of stress in this age group of children. Finally, due to the time commitments needed for this type of data collection for both the participant and researchers, our sample size was limited and was composed of a very limited demographic of children. Even among this limited sample, however, there was significant variability in the frequency and types of stress being reported, drawing attention to the fact that stress is prevalent in children, and may be even more so in larger and more diverse samples.

It is likely that children's experiences of and reactions to stress are complex and varied and the present study only begins to tell this story. Future research should focus on replicating these findings in larger and more diverse samples while including both children and parents' reports of daily stress. This work would not only shed light on discrepancies between reporters, but given that parents may play a key role in both exposure and reactivity to stress, a closer look at their perception may be key to understanding how they influence their children's experiences of stress. Similarly, other factors, such as parent-child relationship quality and the potential spillover from parent to child, will be important to consider. In fact, recent work has documented links between parent-child conflict and children's daily reports of negative mood and school problems, but did not explicitly examine other daily stressors or health symptoms (Timmons and Margolin 2015). Additionally, carrying out a more extensive longitudinal study on children's daily stressful experiences, similar to the National Study of Daily Experiences (NSDE; Almeida et al. 2002), an in-depth survey part of the Midlife in the United States (MIDUS) which began in 1996 and investigates the links between stress and health over time, will provide key insight into both childhood factors and children's experiences of stressor exposure and reactivity. Lastly, an examination of children's coping mechanisms in response to daily stress as predictors of resilience will also be important in understanding how to best support children through parenting, education, or intervention.

#### Compliance with Ethical Standards

**Conflict of Interest** The authors declare that they have no competing interest.

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