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The impact of child and family stressors on the self-rated health of mothers of children with autism spectrum disorder: Associations with depressed mood over a 12-year period

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Abstract

Employing a cohort sequential design and multilevel modeling, the effects of child and family stressors and maternal depressed mood on the self-rated health of 110 mothers of children with autism spectrum disorder were assessed over a 12-year period when children in the study were 7–19 years old. Findings indicate a significant decline in self-rated health over time. In addition, child and family stressors, as well as maternal depressed mood, exerted significant between-persons effects on self-rated health such that mothers who reported more stressors and depressed mood across the study period were less likely to rate themselves in better health across that period. In addition, a significant within-person relationship between maternal depressed mood and self-rated health was found, indicating that at times when mothers reported higher levels of depressed mood than usual (their personal average across the study), they were significantly less likely to report better self-rated health. Finally, maternal depressed mood partially mediated the between-persons effects of child and family stressors on self-rated health such that increased stressors led to increased maternal depressed mood which, in turn, led to poorer maternal self-rated health. Findings suggest that chronic stressors erode maternal health over time and that depression may be an important mechanism linking stressors to decreased maternal health.

Keywords

autism, autism spectrum disorder, depression, mothers, physical health, stress

Introduction

Extensive research indicates that, on average, parents of children with autism spectrum disorder (ASD) experience higher levels of stress and poorer mental health than do parents of typically developing children or children with non-ASD disabilities (for reviews, see Hayes and Watson, 2013; Karst and Van Hecke, 2012). In addition, children with ASD often exhibit high levels of problem behaviors, a fact which has consistently been linked to increased parent stress and psychological distress (Benson, 2006; Benson and Karlof, 2009; Davis and Carter, 2008; Lecavalier et al., 2006). At the same time, research also suggests that the availability and use of psychosocial resources, such as social support (Benson, 2012, 2016; Ekas et al., 2010) and adaptive coping (Benson, 2014; Hastings et al., 2005), can lower parent stress and enhance adjustment.

While a substantial literature has examined the effects of caregiving on the mental health of parents of children with ASD, particularly mothers, fewer studies have investigated how caregiving affects parents' *physical* health. Extant studies, however, suggest that, as a group, parents of children with ASD experience poorer subjective and objective physical health (e.g. poorer self-assessed global health, increased somatic symptoms, and worse health-related quality of life)

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than do parents of typically developing children (Allik et al., 2006; Khanna et al., 2011; Mungo et al., 2007). Similar findings of poorer physical health have also been found in studies of other kinds of family caregivers, including parents of children with severe and chronic medical conditions (Hatzmann et al., 2008; Murphy et al., 2007; Raina et al., 2005) and family members caring for relatives with Alzheimer's disease and other forms of dementia (for reviews, see Pinquart and Sörensen, 2007; Vitaliano et al., 2003).

Research indicates that caregiving stressors can affect parent physical health through a variety of pathways. Maladaptive coping, for example, can result in parents managing stress by engaging in health-damaging behaviors such as smoking and excessive drug and alcohol use (Gallant and Connell, 1998; Schulz and Beach, 1999). At the same time, contending with severe caregiving demands can limit parents' ability to exercise, get adequate rest, and engage in other health promoting activities (Gallagher et al., 2010; Mihaila and Hartley, 2016; Ng and Jeffery, 2003). Caregiving stressors can also adversely affect parent health by negatively impacting psychosocial resources such as social support, optimism, and mastery (Mausbach et al., 2007; Schetter and Dolbier, 2011; Thoits, 2010). Repeated exposure to stressors has also been shown to induce chronic activation of the autonomic, neuroendocrine, and immune systems (Juster et al., 2010). The *allostatic load model* (McEwen, 1998) proposes that chronic activation of these systems can promote pathophysiological processes that increase risk for a variety of diseases, including cancer, diabetes, and cardiovascular disease (Seeman et al., 1997; Steptoe et al., 2014).

In addition to caregiving stressors, research has identified other psychological factors which may contribute to decreased caregiver health. One such factor is *depressed mood*. Research suggests that negative emotions, such as anger, anxiety, and depression, can exert negative effects on physical health (see Consedine and Moskowitz, 2007, for a review). As is the case with stressors, depressed mood has been linked to problematic health behaviors, including smoking, substance use, and physical inactivity (Strine et al., 2008). Researchers have identified several physiological pathways, including endocrine and immune system dysregulation, through which depression can adversely impact health (see Burke et al., 2005; Kiecolt-Glaser et al., 2002 for reviews). Depressed mood has also been associated with poorer self-assessed physical health in general population surveys (e.g. Han, 2002; Molarius and Janson, 2002; Moussavi et al., 2007) and in studies of family caregivers (Pinquart and Sörensen, 2007; Vitaliano et al., 2003). Nevertheless, despite this documented association, only one study to date has examined the effect of depressed mood on the physical health of parents of children with ASD. In that online survey, Bekhet (2014) found a significant relationship between increased depressed mood and poorer parent self-reported health.

In examining potential relationships between stressors, depressive symptoms, and physical health, it is also important to consider the potential *mediating* and *moderating* effects of depressed mood on the associations between stressors and health. In general terms, *mediation* addresses how an effect is produced, with mediational analyses attempting to identify the intermediary mechanism through which a specific predictor variable affects an outcome. In contrast, *moderation* focuses on factors that may alter the relationship between a predictor and outcome; as such, moderational analyses attempt to identify individual differences or contextual factors that strengthen and/or change the direction of the predictor–outcome association (Baron and Kenny, 1986). Prior research (Jones et al., 2003), including research on family caregivers (Eisenhower et al., 2009; Mittelman et al., 2007), suggests that depression may both mediate and moderate the link between chronic stressors and physical health. In a longitudinal study comparing self-reported health among parents of children with and without developmental delays (DD), for example, Eisenhower et al. (2009) found parent depressed mood to partially mediate the relationship between early child problem behaviors and later parent self-reported health. In addition, in the same study, Eisenhower et al. found parent depressed mood to moderate the association between child problem behaviors and self-reported health among parents of children with DD, with the adverse effects of child problem behaviors on self-reported health being strongest when parents reported increased depressed mood.

To sum up, while extant research clearly suggests that parenting a child with ASD can result in decreased physical health, our understanding of why this is so remains limited. There may be several possible reasons for this. First, compared to research on other types of family caregivers, such as dementia caregivers, relatively few studies of physical health among parents of children with ASD have been conducted. In addition, when considering stressors potentially linked to poorer parent health, it is important to remember that parents of children with ASD, like all parents, experience an array of life stressors, many of which may not be directly related to the child with ASD (Osborne and Reed, 2009; Wong et al., 2012). As such, it is important to consider both *child* and *non-child* stressors when examining the link between stressors and parent health. It is also important to examine potential mediators and moderators of the stress–health relationship, including factors such as depressed mood which may help to explain the mechanism through which, and/or the conditions under which, child and non-child stressors adversely affect parent health (Eisenhower et al., 2009). Finally, it is important for researchers to examine parent physical health from a *longitudinal* perspective, thus allowing for the examination of both *intraindividual* and *interindividual* variations in parent health over time. However, with the notable

exception of the work of Seltzer et al. (Seltzer et al., 2010; Smith et al., 2012; Wong et al., 2012), to date, research on the physical health of parents of children with ASD has been almost exclusively cross-sectional.

In an attempt to address these limitations, this study employed a cohort sequential design (Raudenbush and Chan, 1993) to examine the self-rated health (SRH) of 110 mothers of children with ASD over a 12-year period when children with ASD in the study were 7–19 years old. Employing multilevel modeling (MLM), the analyses focused, in particular, on assessing the between-persons and within-person effects of three time-varying predictors, child problem behavior severity, stressful family events, and maternal depressed mood, on maternal SRH over time. Because time-varying measures contain information on both *within-person fluctuation or change* (how much a person deviates from his or her own personal average at a given point in time) and *between-persons differences* (how much a person differs from others across time on the same measure), methodologists have emphasized the importance of disaggregating within-person and between-persons effects in the analysis of longitudinal data (Curran and Bauer, 2011; Hoffman and Stawski, 2009; Wang and Maxwell, 2015).

This study had three aims: (1) to examine within-person change in maternal SRH over time, (2) to investigate the within-person and between-persons effects of child and family stressors and maternal depressed mood on maternal SRH, and (3) to assess the potential mediating and moderating effects of maternal depressed mood on the relationship between child and family stressors and maternal SRH. Based on a review of the literature, several hypotheses were posited. First, it was expected that maternal SRH would decline over the 12-year period surveyed (child age 7–19) and that older mothers would begin the study with poorer SRH compared to younger mothers. In addition, it was expected that both child problem behavior severity and stressful family events would be negatively associated with maternal SRH, both in terms of between-persons differences and within-person change over time. It was also expected that at least some of the within-person and between-persons effects of child problem behavior severity and stressful family events on SRH would be indirect, mediated by maternal depressed mood. Finally, it was expected that maternal depressed mood would moderate the within-person and between-persons associations of child and family stressors with maternal SRH such that the relationships between stressors and SRH would be stronger among mothers reporting higher levels of depressed mood.

Methods

Participants

Data for this study were drawn from an ongoing longitudinal study of children with ASD and their families (e.g. Benson, 2010; 2012, 2014, 2016). The full study sample (142 children and 136 parents) was recruited into the study from a wide variety of public and private schools, multi-system special needs programs, and autism service organizations located in eastern and central Massachusetts. Data for the study were collected at five points in time (2006, 2008, 2010, 2012–2013, and 2015–16) from a subsample of 110 mothers with coresiding children whose ASD diagnoses were confirmed using the *Autism Diagnostic Interview–Revised* (ADI-R; Lord et al., 1994). Over the five waves, the number of mothers participating at each assessment was 110 (Time 1), 107 (Time 2), 98 (Time 3), 59 (Time 4), and 82 (Time 5). Across waves, 48% participated in all five assessments, 23% in four, 14% in three, 9% in two, and 6% in one.

In terms of parent and family characteristics, at baseline (Time 1), the mean age of participating mothers was 42.1 years (standard deviation (SD) = 5.2). In total, 93% were either married or living with a partner and 66% were college graduates. Participants' total annual family income at baseline averaged between $80,000 and $89,000, but varied substantially within the sample from under $30,000 (14%) to over $149,000 (14%). Finally, in terms of race/ethnicity, 85% of mothers identified themselves as Caucasian.

In regard to the children with ASD, most were male (86%), with a mean age at baseline of 8.6 years (SD = 1.5). At baseline, 33% of the children were diagnosed with autism, 29% with PDD-NOS (Pervasive Developmental Disorder–Not Otherwise Specified), 14% with Asperger syndrome, and 26% with an unspecified ASD. Approximately one-fifth (19%) of children were reported as nonverbal. In terms of school programs, at baseline, 70% attended public schools, while the remainder attended either a private or a multi-district collaborative special needs program.

Measures

Maternal SRH. Maternal SRH was assessed across all five waves using a single-item measure, "In general, how would you describe your current physical health?" Response categories were 1 = Poor, 2 = Fair, 3 = Good, 4 = Very good, and 5 = Excellent. Despite being based on a single question, this health measure has been shown to consistently predict morbidity and mortality across a wide range of health conditions and populations (see reviews by Idler and Benyamini, 1997; Jylhä, 2009; Mavaddat et al., 2014). Previous research has also demonstrated the measure's construct validity among ethnically diverse groups (e.g. Bzostek et al., 2007), parents in general (e.g. Von der Lippe and Rattay, 2016), and parents of persons with ASD, DD, and other disabilities (Bekhet, 2014; Eisenhower et al., 2009; Mittelman et al., 2007).

Child problem behavior severity. Severity of child problem behavior was assessed at each assessment using the 66-item problem behavior scale of the *Nisonger Child Behavior Rating Form–Parent Version* (NCBRF; Aman et al., 1996). The NCBRF problem behavior scale utilizes a 4-point scale (0 = Did not occur or was not a problem to 3 = Occurred a lot or was a serious problem) to assess several broad dimensions of maladaptive behavior common in children with ASD, including noncompliance, hyperactivity, self-injury, aggression, ritualism, and irritability (Lecavalier et al., 2004). Possible scores range from 0 to 198, with higher scores indicating more severe or frequent problem behaviors. Inter-item reliability for the NCBRF problem behavior scale in this study ranged from 0.91 to 0.93 across assessments.

Stressful family events. Using the life events scale of the *Parenting Stress Index* (Abidin, 1995), at each assessment point, mothers were asked to indicate whether any of 21 stressful events (e.g. divorce or separation, unemployment, death of a parent, or close family member) had occurred to them or an immediate family member during the previous year (1 = Yes; 0 = No). The scale ranges from 0 to 21 and indicates the total number of stressful family events reported by the mother.

Maternal depressed mood. Mothers' level of depressed mood was measured at each assessment point using a short form of the *Center for Epidemiologic Studies Depression Scale* (CES-D; Radoff, 1977; Ross and Mirowsky, 1984). Using the CES-D short form, respondents were asked to indicate on how many days (0–7) during the past week they had experienced seven common depressive symptoms (e.g. "felt sad" and "felt that everything was an effort"). Responses on the items were added to produce a total index score ranging from 0 to 49. Inter-item reliability for the CES-D short form ranged from 0.84 to 0.88 across assessments.

Child age. Age of the child with ASD (in years and months) was recorded across all assessments.

Time-invariant covariates. In addition to the study's time-varying predictors, several time-invariant measures were also included as controls utilizing data collected at baseline only. *Child gender* was dummy-coded: 1 = male and 0 = female. *Child autism symptom severity* was assessed using the *Social Responsiveness Scale* (SRS; Constantino and Gruber, 2007), a 65-item index that assesses the frequency of a wide array of autistic traits (e.g. social awareness, reciprocal social behavior, and stereotypic/repetitive behavior). Because 19% of children with ASD in the study were reported as nonverbal, 12 SRS items assuming verbal language use by the child were excluded from the measure, resulting in a 53-item symptom severity scale (inter-item reliability = 0.92). Finally, *family SES* (socioeconomic status) was assessed using an additive index consisting of the standardized mean education score for mothers and fathers (raw score range: 1 = grade school to 7 = doctoral degree; father mean = 4.89, SD = 1.27; mother mean = 4.90, SD = 1.60) and the standardized annual income score for each family (raw score range: 1 = less than $10,000 a year to 16 = $150,000 a year or more; mean = 8.96, SD = 4.27). In mother-only families (n = 7), only the standardized maternal education and income scores were utilized, with the final SES score weighted to adjust for the number of parents in the household.

Table 1 presents descriptive data on study measures broken down by wave.

Study design and data analysis plan

Because repeated measures were nested within subjects (i.e. mothers), MLM was used to analyze study data (Hox, 2010). Use of MLM has several advantages over traditional longitudinal methods, such as repeated measures analysis of variance (ANOVA), since it allows for within-subject dependence, missing data (assuming data are missing at random), varying numbers of assessments between subjects, and unequal spacing between assessments (Singer and Willett, 2003). In addition, a key strength of MLM is that intraindividual and interindividual variability in a time-varying predictor can be easily disaggregated to permit separate, simultaneous tests of within-person and between-persons relations between repeated measures (e.g. Hoffman and Stawski, 2009).

Employing a *cohort sequential design*, data were collected from participating mothers over five assessment waves when the children with ASD in the study were approximately 7–10, 9–12, 11–14, 13–16, and 15–19 years old. Cohort sequential designs (also called accelerated longitudinal designs) involve the collection of data from multiple, overlapping age cohorts, thus allowing for the assessment of change over longer periods of time than would be possible using conventional longitudinal methods (Raudenbush and Chan, 1993). In preliminary MLM analyses with this sample (not shown), no evidence of age cohort differences in SRH trajectories was found, thus indicating that cohorts could be combined to estimate a single trajectory from child age 7–19 (Miyazaki and Raudenbush, 2000).

Because the study's outcome, maternal SRH, is measured on an ordinal scale (1 = poor health to 5 = excellent health), multilevel ordered logistic regression was used to model study effects (Liu, 2016). Using this statistical approach, the extent of within-person change in SRH over the 12-year study period was first assessed by estimating a model employing within-person child age (the study's metric of time), between-persons child age, and baseline maternal age as predictors (Model 1). Next,

Table 1. Descriptive statistics for study measures by wave of data collection.

	Time 1		Time 2		Time 3		Time 4		Time 5	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Outcome										
Maternal self-rated health (SRH)	3.446	0.995	3.187	1.010	3.200	1.050	3.268	1.053	3.233	0.960
Time-varying predictors										
Child age	8.578	1.479	10.278	1.238	11.933	1.237	14.927	1.235	17.396	1.178
Child problem behavior severity	51.291	23.338	50.980	23.494	49.901	24.042	40.408	19.006	39.965	22.456
Number of stressful family events	3.046	2.328	2.925	2.209	2.946	2.135	2.881	2.513	1.821	2.025
Maternal depressed mood	15.310	12.219	14.850	11.965	14.011	10.835	13.750	13.180	15.066	12.282
Time-invariant covariates										
Child gender (1 = male)	0.854	0.345								
Child autism symptom severity	127.727	22.018								
Maternal age	42.100	5.160								
Family SES	0	1.650								
Total N	110		107		98		59		82	

SD: standard deviation; SES: socioeconomic status.
Data on time-invariant covariates were collected at Time 1 only. Family SES is a standardized composite measure with a mean of zero.

three hierarchical models were estimated assessing the impact of predictors on maternal SRH over time: a model including only study covariates (Model 2), a model including covariates and child and family stressors (Model 3), and a model including covariates, stressors, and maternal depressed mood (Model 4). In addition, the potential mediating effects of maternal depressed mood on the relationships between stressors and SRH were assessed using procedures developed by Breen et al. (2013) for assessing indirect effects in logistic and other nonlinear models. In addition, the potential moderating effects of depressed mood on the relationships between child and family stressors and SRH were assessed by estimating an additional model which included Model 4 predictors and the interaction of child problem behavior severity × maternal depressed mood and stressful family events × maternal depressed mood, with each interaction being assessed at the within-person and between-persons level. For all models, time-varying predictors were appropriately centered to disaggregate within-person and between-persons effects (e.g. Hoffman and Stawski, 2009). Time-averaged measures were used to assess between-persons effects and were created by averaging each individual's scores on time-varying predictors across all waves they participated in and then grand-mean centering each measure (i.e. subtracting the mean for the sample from each individual's score). Within-person effects were assessed using time-varying measures that were person-mean centered by subtracting the mean for the individual across assessments from their score at each assessment. In addition, baseline family SES and child autism severity were grand-mean centered. Finally, all models included random effects for subject and child age, with the covariance matrix designated as unstructured. Analyses were conducted using Stata, version 14.0 (StataCorp, College Station, TX).

Results

As a first step in the analyses, a model assessing change over time in maternal SRH was estimated including only within-person child age (time), between-persons child age, and baseline maternal age as predictors. In this initial model (Table 2, Model 1), maternal SRH was found to decline significantly from child age 7 to 19 ($b = -0.065$, $p = 0.043$, 95% confidence interval (CI): −0.129 to −0.001). The odds ratio (OR) associated with this model was 0.937 (calculated as $e^{-0.065}$), indicating that for each yearly increase in child age from 7 to 19, the odds of mothers rating themselves in a higher SRH category (in better health) decreased by 6.3% (calculated as $1 - 0.937 \times 100\%$). Between-persons child age and baseline maternal age were not significantly related to SRH in this initial model.

Next, three additional models predicting maternal SRH were estimated (see Table 2, Models 2–4). As shown in Model 2 (column 4–5), none of the time-invariant covariates was found to significantly predict maternal SRH. When child and family stressors were added in Model 3 (columns 6–7), however, both child problem behavior severity ($b = -0.034$, $p = 0.037$, OR = 0.966, 95% CI: −0.066 to −0.002) and stressful family events ($b = -0.793$, $p < 0.001$, OR = 0.452, 95% CI: −1.142 to −0.444) were found to exert significant, negative between-persons effects on SRH. These findings indicate that mothers who reported more severe child behavior problems across the 12-year study period were significantly less likely to rate themselves in better health across that period. Similarly, mothers who reported more stressful family events across

Table 2. Multilevel ordered logistic models predicting maternal self-rated health (SRH).

Fixed effects	Model 1		Model 2		Model 3		Model 4	
	b	OR	b	OR	b	OR	b	OR
Child age (BP)	0.165 (−0.161 to 0.492)	1.180	0.193 (−0.185 to 0.571)	1.213	0.118 (−0.211 to 0.446)	1.125	0.071 (−0.248 to 0.390)	1.073
Child age (WP)	−0.065* (−0.129 to −0.001	0.937	−0.089 (−0.178 to 0.001)	0.914.	−0.109* (−0.206 to −0.013)	0.896	−0.108* (−0.204 to −0.012)	0.898
Maternal age (Time 1)	−0.032 (−0.140 to 0.077)	0.969	−0.034 (−0.160 to 0.092)	0.965	−0.039 (−0.149 to 0.070)	0.962	−0.027 (−0.132 to 0.078)	0.973
Child gender (1 = male)			1.074 (−0.739 to 2.888)	2.930	0.962 (−0.607 to 2.530)	2.617	0.923 (−0.581 to 2.426)	2.516
Autism symptoms (Time 1)			−0.011 −0.039 to 0.017)	0.989	−0.001 (−0.028 to 0.026)	0.998	0.001 (−0.025 to 0.027)	1.001
Family SES (Time 1)			0.325 (−0.288 to 0.939)	1.385	0.022 (−0.518 to 0.562)	1.022	−0.130 (−0.654 to 0.394)	0.878
Child behavior problems (BP)					−0.034* (−0.066 to −0.002)	0.966	−0.014 (−0.467 to 0.019)	0.986
Child behavior problems (WP)					−0.009 (−0.026 to 0.008)	0.998	−0.007 (−0.024 to 0.011)	0.993
Stressful family events (BP)					−0.793** (−1.142 to −0.444)	0.452	−0.572** (−0.172 to −0.039)	0.564
Stressful life events (WP)					−0.081 (−0.234 to 0.071)	0.922	−0.069 (−0.221 to 0.082)	0.933
Maternal depressed mood (BP)							−0.106*** (−0.172 to −0.039)	0.900
Maternal depressed mood (WP)							−0.034* (−0.067 to −0.001)	0.967
Fit statistics								
−2 log likelihood	1018.572		967.662		934.594		919.294	
AIC	1034.573		993.662		968.595		957.295	
BIC	1067.176		1046.216		1037.319		1034.060	

SES: socioeconomic status; BP: between-persons effects; WP: within-person effects; b: unstandardized fixed effect coefficients; AIC: Akaike information criterion; BIC: Bayesian information criterion; OR: odds ratio.
N = 110 (observations = 435). Models include random effects for subject and child age. Model cut-points and random effects are not shown.
*$p < 0.05$; **$p < 0.001$; ***$p < 0.01$.

Table 3. Results of mediation analyses predicting maternal self-rated health (SRH).

	Between-persons effects			Within-person effects		
	Estimate	SE	95% CI	Estimate	SE	95% CI
Depression as mediator of the effect of child behavior on maternal SRH						
Total effect	−0.031*	0.014	−0.058 to −0.003	−0.004	0.008	−0.020 to 0.011
Direct effect	−0.013	0.015	−0.043 to 0.016	−0.001	0.008	−0.017 to 0.014
Indirect effect	−0.017**	0.006	−0.028 to −0.006	−0.002	0.002	−0.006 to 0.000
Depression as mediator of the effect of stressful life events on maternal SRH						
Total effect	−0.728***	0.152	−1.026 to −0.432	−0.090	0.070	−0.228 to 0.048
Direct effect	−0.517***	0.160	−0.833 to −0.202	−0.077	0.071	−0.216 to 0.061
Indirect effect	−0.211**	0.071	−0.351 to −0.072	−0.013	0.009	−0.031 to 0.006

CI: confidence interval; SE: standard error; SRH: self-rated health.
N = 110 (observations = 435). Models utilize multilevel ordered logistic regression and include all covariates. Total effect refers to the effect of the maternal stressor (child behavior severity or stressful family events) on SRH, controlling for everything but depressed mood (the proposed mediator). Direct effect refers to the effect of the maternal stressor on SRH controlling for depressed mood. Indirect effect refers to the effect of the maternal stressor on SRH via depressed mood. Indirect effects were calculated using the KHB method (Breen et al., 2013).
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

the study period (child age 7–19) were also significantly less likely to rate themselves in better health across that period. In this model, no significant within-person effects for child problem behavior severity or for stressful family events were found, indicating that the impact of child and family stressors on maternal SRH occurred wholly at the interindividual level.

As shown in Model 4 (columns 8–9), when maternal depressed mood was included in the model, it exerted both significant within-person and between-persons effects on maternal SRH. In regard to depression's between-persons effect on SRH (b = −0.106, p = 0.002, OR = 0.900, 95% CI: −0.172 to −0.039), findings indicate that mothers who reported higher levels of depressed mood across the study period (child age 7–19) were significantly less likely to rate themselves in better health across that period. In terms of depressed mood's within-person effect on SRH (b = −0.034, p = 0.049, OR = 0.967, 95% CI: −0.066 to −0.001), findings indicate that at times when mothers reported greater depressed mood than usual (their personal average across the 12-year study period), they were significantly less likely to rate themselves as being in better health.

In addition to assessing the direct effects of stressors and depression on maternal SRH, the possibility that child and family stressors might *indirectly* affect SRH via their impact on maternal depressed mood was also investigated. The results of these mediation analyses are presented in Table 3 based on estimation procedures developed by Breen et al. (2013) for the analyses of indirect effects in nonlinear models. As shown, at the between-persons level (but not the within-person level), maternal depressed mood partially mediated both the relationships between child problem behavior severity and SRH (indirect effect = −0.017, p = 0.004, 95% CI: −0.028 to −0.006, total effect mediated = 56%) and stressful family events and SRH (indirect effect = −0.211, p = 003, 95% CI: −0.351 to −0.072, total effect mediated = 29%). For illustrative purposes, using procedures developed by Baron and Kenny (1986), these two mediating effects are diagramed in Figure 1 based on a series of linear MLM regressions treating maternal SRH as a continuous (rather than ordinal) outcome. As shown, in both mediation models, an increase in both stressors (child problem behavior severity and stressful family events) was found to result in increased maternal depressed mood which, in turn, led to decreased maternal SRH.

As a final step in the analyses, the potential moderating effects of maternal depressed mood on the relationships between child and family stressors and maternal SRH were examined. To assess these potential moderating effects, two sets of multiplicative terms were created representing the within-person and between-persons interactions of maternal depressed mood and child problem behavior severity and depressed mood and stressful family events. When these four interaction terms were added to Model 4, none was found to be significant, indicating that the effects of child and family stressors on SRH did not vary by level of maternal depressed mood.

Discussion

Prior research indicates that providing care for a disabled family member can exert pronounced negative effects on the mental and physical health of family caregivers (Pinquart and Sörensen, 2007; Vitaliano et al., 2003), including parents of children with ASD (Allik et al., 2006; Khanna et al., 2011; Mungo et al., 2007). Compared to other family caregivers, however, relatively little is known about the physical health of parents of children with ASD, in particular, how parent health changes over time and how these changes relate to characteristics of the child, parent, and family. To address these gaps in the literature, this

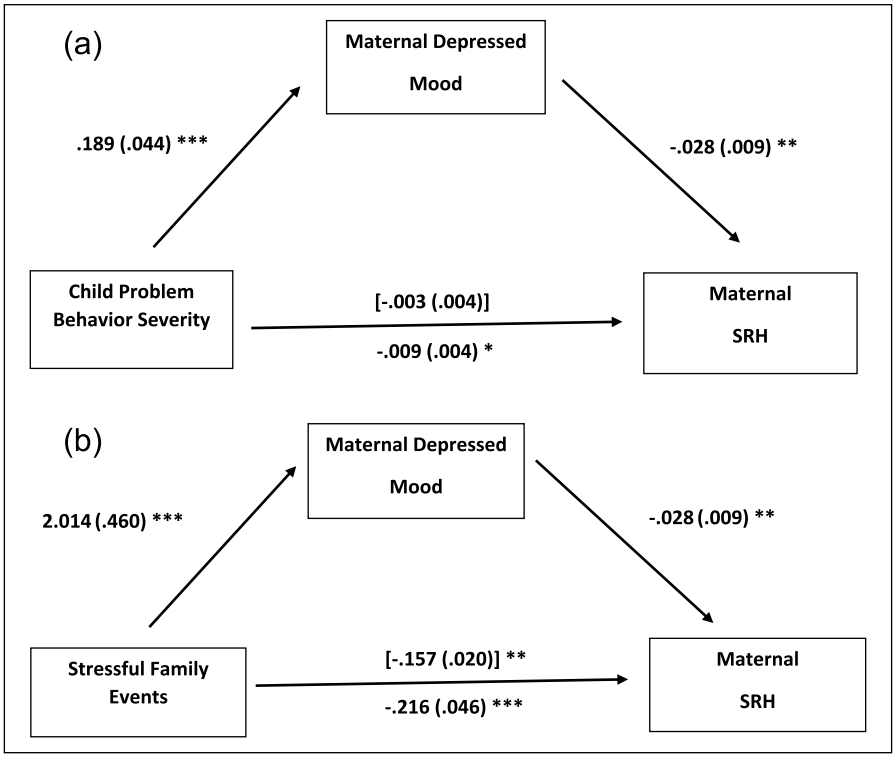

Figure 1. Diagrams illustrating significant mediating effects of maternal depressed mood on the relationship between stressors and maternal self-rated health (SRH): (a) mediating effect of depression on relationship between child problem behavior severity and SRH and (b) mediational effect of depression on the relationship between stressful family events and SRH.
Coefficients are unstandardized fixed effects from multilevel models treating SRH as a continuous measure (standard errors in parentheses). Coefficients in brackets are based on MLM regression employing both the stressor and depression as predictors of SRH. Models include all covariates. *$p<0.05$; **$p<0.01$; ***$p<.001$.

study used a cohort sequential design and MLM to assess the SRH of 110 mothers of children with ASD over a 12-year period when children with ASD in the study were 7–19 years old. The specific aims of the study were (1) to examine change in maternal SRH over time, (2) to investigate the within- and between-persons effects of child and family stressors and maternal depressed mood on maternal SRH, and (3) to assess the potential mediating and moderating effects of maternal depressed mood on the relationship between child and family stressors and maternal SRH.

Turning to the study's first aim, the examination of change in maternal SRH over time, as hypothesized, a significant reduction in the odds of mothers rating themselves in better health was noted over the 12-year period examined. This finding is noteworthy, given that prior longitudinal research has found declines in SRH over time to be associated with increased morbidity and mortality (Leinonen et al., 2002; Manor et al., 2001; Rodin and McAvay, 1992). While informative, it should be noted that assessing *average* change in SRH (as was done here) may obscure important subgroup differences in SRH trajectories (Liang et al., 2010). For example, in a recent US study of change in SRH over 9 years, Ayyagari et al. (2012) uncovered four distinct SRH trajectories: *persistently good health, good but declining health, persistently fair health*, and *fair but declining health*. Based on these and similar findings (e.g. Benyamini et al., 2009), future longitudinal studies examining parent SRH may wish to consider assessing potential subgroup heterogeneity in SRH trajectories over time using person-centered analytic approaches such as latent profile or latent class analysis (for a recent example of the use of this approach in autism family research, see Woodman et al., 2016).

In regard to the study's second aim, the examination of the impact of child and family stressors and maternal depressed mood on maternal SRH, both types of stressors were found to exert a significant, negative between-persons effect on SRH, with mothers reporting more severe child problem behaviors and more stressful family events across the 12-year study period being less likely to rate themselves in better health across this period. These findings are consistent with a large body of research indicating that child problem behaviors constitute a major stressor on parents of children with ASD (Benson and Karlof, 2009; Lecavalier et al., 2006). Findings also support prior research indicating that non-child stressors can also contribute to poor parent health (Reed et al., 2016; Wong et al., 2012). In addition, study results indicating significant *between-persons* (but

not *within-person*) relationships between stressors and SRH suggest that it is chronic exposure to child and family stressors across time that erodes maternal health rather than fluctuations over time in the level of stressors experienced by mothers.

In regard to the impact of depressed mood on maternal SRH, as hypothesized, and in line with prior research (e.g. Eisenhower et al., 2009; Han, 2002), maternal depressed mood was found to exert significant, negative within-person and between-persons effects on SRH. In regard to depression's between-persons effect on SRH, mothers who reported higher levels of depressed mood across the study period were significantly less likely to report being in better health across that period, while in terms of depression's within-person effect, at times when mothers reported higher than usual levels of depressed mood (i.e. higher than their own personal average across time), they were also less likely to rate themselves in better health. Taken as a whole, these findings suggest that poorer SRH is linked both to chronically high levels of maternal depressed mood and to increases over time in mothers' own level of depressive symptoms.

In addition to examining change in maternal SRH and the effects of stressors and maternal depressed mood on SRH, a third aim of the study was to assess depressed mood's potential mediating and moderating effects on the relationship between stressors and SRH. While no moderating effects were uncovered, depressed mood was found to partially mediate the between-persons effects of both child problem behavior severity and stressful family events on SRH. Thus, while some of each stressor's between-persons impact on SRH was direct, some was *indirect*, with higher levels of each stressor resulting in higher levels of maternal depressed mood, which, in turn, resulted in poorer maternal SRH. This finding is consistent with previous research linking chronic stressors to depression (Thoits, 2010) and depression to decreased physical health (Han, 2002). It also supports the findings of Eisenhower et al. (2009) who found parent depressed mood to partially mediate the impact of child behavior problems on SRH among parents of children with DD.

Finally, it should be noted that several time-invariant covariates were found not to be significantly related to maternal SRH in this study, including child gender, child autism symptom severity, and family SES. The insignificant association between child autism symptom severity and maternal SRH is unsurprising and consistent with prior studies (Benson and Karlof, 2009; Hastings and Brown, 2002; Smith et al., 2008) that have generally found parent mental and physical health to be more adversely impacted by child problem behaviors than by autism symptomatology, per se. However, given robust findings linking SES and health, both in general population surveys (Phelan et al., 2004; Mirowsky and Ross, 2003a) and in studies of parents of children with disabilities (Eisenhower et al., 2009; Emerson, 2003), it is surprising that family SES was not a significant predictor of maternal SRH in the present investigation. While the reason for this unexpected null finding is unclear, it may be due, in part, to the generally high education and income levels of the present parent sample.

When considering study findings, it is important to acknowledge study limitations as well. The size of the present sample, while larger than that used in some prior family studies, was still relatively small, thus potentially limiting the study's ability to detect potentially meaningful relationships between study variables. In addition, it should also be noted that mothers participating in the study were largely Caucasian, well educated, and economically well off, thus limiting the generalizability of study findings to other racial and socioeconomic groups. In addition, the fact that the sample was restricted to mothers is another important study limitation, given that previous research suggests that the mental and physical health of mothers and fathers may be impacted differently by the demands of parenting a child with ASD (Allik et al., 2006; Foody et al., 2015; Jones et al., 2013).

In addition, while the one-item SRH measure used in this study has been widely used in prior research (e.g. Eisenhower et al., 2009; Mavaddat et al., 2014), the measure's brevity and generality clearly limit its ability to assess physical health objectively and comprehensively. Furthermore, it has long been established that SRH and other subjective health measures "assess at least two distinct sources of variance, one that is clearly health-relevant and another that is more subjective and psychological" (Watson and Pennebaker, 1989: 245). In this regard, research suggests that individuals who are prone to negative emotional states, including depressed mood, may be more likely than others to evaluate their health negatively (Cohen et al., 1995; Segerstrom, 2013). Given this potential confounding of psychological and physical health elements within the study's SRH measure, future research examining the link between stress, depression, and physical health should attempt to gather information on respondent's physical health utilizing a variety of sources, including subjective health assessments and more objective health measures such as detailed symptom checklists and health-related physiological measures.

Finally, limitations concerning study design should be noted. Because the study did not include a comparison group of mothers of typical developing children or children with non-ASD disabilities, it was not possible to examine how the health effects on mothers of parenting children with ASD might differ from those of parenting other types of children (Seltzer et al., 2004). In addition, because data in this study were collected concurrently over time on both predictors and the SRH outcome, it is not possible to determine unambiguously the causal ordering between these variables. Thus, while study hypotheses

clearly assumed causal effects flowing from child and family stressors to maternal depression to SRH, it is also possible that these effects might be reversed or reciprocal in nature (Mittelman et al., 2007; O'Rourke et al., 2003). In addition, it is possible that parents with higher levels of depressed mood may rate their levels of child and family more highly than others (De Los Reyes and Kazdin, 2005). For this reason, future studies should consider the use of alternate statistical approaches, such as longitudinal structural equation modeling, in order to more comprehensively assess causal relationships among study variables (Little, 2013). Use of a variety of informants regarding child behavior, including spouses, teachers, and the children themselves, would also lessen problems associated with shared method variance.

Despite these limitations, this study has a number of strengths. It is one of the few studies to date to examine SRH in parents of children with ASD and the first to do so using a long-term longitudinal design. Employing a cohort sequential design, the study was able to assess the relationship between maternal SRH and several key child, parent, and family predictors over a period spanning middle childhood to late adolescence. Study results indicate, even after controlling for baseline maternal age, that maternal SRH declined significantly over time. In addition, increased child and family stressors were found to be associated with decreased maternal SRH, while the between-persons effects of child and family stressors on SRH were partially mediated by maternal depressed mood. Taken together, these results suggest that interventions addressing a variety of parent and child needs are necessary in order to affect positive changes in maternal physical health. These include efforts to reduce challenging child behaviors (Doehring et al., 2014), as well as interventions, such as mindfulness and cognitive behavioral training, aimed at reducing the adverse impact of stressors on parent mental and physical health (Hastings and Beck, 2004). Health professionals should also be aware that parents of children with ASD may be at increased risk for physical health difficulties. Given the documented link between caregiving stressors, emotional distress, and physical health, screening for depression and other mental health problems should be undertaken, particularly in general practice settings, and where appropriate, referrals to support services should be made and pharmaceutical and non-pharmaceutical treatments for mental health problems initiated. Parents should also be encouraged to engage in health promoting behaviors such as physical exercise, healthy eating, and other forms of self-care known to have positive effects on both emotional and physical health (Edelman et al., 2013).

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