Journal of Child & Adolescent Trauma (2019) 12:437–445
https://doi.org/10.1007/s40653-019-0248-x

ORIGINAL ARTICLE

Child Maltreatment, Chronic Pain, and Other Chronic Health Conditions in Youth in Foster Care

Lindsay Huffhines[1] · Yo Jackson[2]

Published online: 23 January 2019

Abstract

Childhood maltreatment is associated with chronic pain in adults. The goals of this study were 1) to examine this relation in youth placed in foster care with high levels of maltreatment exposure, and 2) to investigate the relation between maltreatment frequency and acute pain, and maltreatment frequency and general chronic health condition. Participants included 403 youth ages 8–19 who resided in foster or residential/group homes. Youth with more maltreatment events had higher odds of chronic pain in a dose response fashion. There was no significant relation between maltreatment type and pain diagnosis, or maltreatment and general chronic health condition. This study examined both self- and case file report of maltreatment frequency and type in association with chronic pain, acute pain, and general chronic health condition in a sample of youth in foster care, providing evidence that more maltreatment exposure increases the likelihood of chronic pain, even in youth. This suggests that it may not take decades for the overloaded stress response system to lead to a serious pain condition, but that this process may occur much earlier in the lifespan. The findings have important implications for professionals working to prevent and treat the effects of child maltreatment or chronic pain.

Keywords Chronic pain · Acute pain · Chronic illness · Physical health · Pediatrics · Childhood maltreatment · Childhood adversity · Foster care

For decades, physical and sexual abuse has been thought to impact the development of chronic pain (Kendall-Tackett 2001). More recently, exposure to maltreatment in childhood has been shown to increase the risk of occurrence of chronic pain syndromes in adults across multiple studies (Green et al. 2001; Jones et al. 2009). Adults with a significant history of child maltreatment also report problems with abdominal pain, pelvic pain, fibromyalgia, musculoskeletal pain, headaches, and back pain (Anda et al. 2010; Imbierowicz and Egle 2003; Kopec and Sayre 2005; Lampe et al. 2003). Little research to date, however, has examined these associations in children and adolescents. As such, it is unknown whether chronic pain may occur much closer in time to maltreatment exposure than is currently demonstrated by the extant literature. This information is important in understanding the more immediate effects of child maltreatment and will greatly inform healthcare practices for children exposed to maltreatment. It will also contribute to the knowledge base on chronic pain etiology, and how it develops over the lifespan. Moreover, the complex interaction of biological and psychosocial factors contributing to chronic pain is only partially understood in adults, much less in youth (Van Hecke et al. 2013).

Chronic pain, defined by the International Association for the Study of Pain as recurrent or persistent pain lasting three months or more, is common in youth (Merskey and Bogduk 1994). For the most predominant types of pain in youth – headache, abdominal pain, back pain, and musculoskeletal pain – prevalence rates range from 4% to 88% (King et al. 2011). Chronic pain impacts social and physical functioning, school attendance, and family life (Palermo et al. 2014). Given these consequences, identifying preventable or treatable factors in youth, such as child maltreatment, is paramount. Moreover, children and adolescents who experience chronic pain are more likely to become adults with chronic pain conditions (King et al. 2011).

✉ Lindsay Huffhines
lindsay.huffhines@ku.edu

[1] Clinical Child Psychology Program, University of Kansas, 1000 Sunnyside Avenue, Lawrence, KS 66045, USA

[2] Department of Psychology, Pennsylvania State University, State College, PA, USA

Although there is substantial evidence that maltreatment may be linked to increased risk for chronic pain, maltreatment itself is a broad, multifaceted construct, and pain outcomes may differ for those exposed to different quantities and types of maltreatment. Exposure to childhood maltreatment, like exposure to other significant traumas, results in activation of the sympathetic nervous system (SNS) and hypothalamic-pituitary-adrenocortical (HPA) axis, which leads to a cascade of changes in the nervous, cardiovascular, endocrine, and immune systems (Hostinar et al. 2014; Shonkoff et al. 2012). This stress response, while beneficial in the short-term, becomes maladaptive if it is repeatedly or continuously activated (Cohen and Wills 1985; Dickerson and Kemeny 2004; Miller et al. 2011; Segerstrom and Miller 2004). When maltreatment occurs for a prolonged period, or frequently occurs, the stress response system is overactivated. This overactivation and subsequent physiological changes results in physical health problems (Glaser and Kiecolt-Glaser 2005; Miller et al. 2007; Miller et al. 2011; Nusslock and Miller 2016). Thus, it is particularly important to examine not only how type of abuse, as past studies have done, but frequency of abuse, impacts chronic pain.

Further, there are two common methods of gathering maltreatment history in older children and adolescents: child protective services case file reports, and self-report. Researchers typically use one method or the other—case file reports or youth self-report—to determine if and how youth have experienced maltreatment (Hambrick et al. 2014). To move beyond inclusion of different methods that may provide discrepant results, the present study included both.

There is a clear need for research that examines youths' experience of maltreatment and subsequent chronic pain before the youth reaches adulthood. The objective of the current study was to explore the relation between maltreatment characteristics (i.e., frequency, type) and the presence of chronic pain while accounting for relevant demographic factors (e.g., age, gender, race, foster placement type). It was expected that youth who reported more frequent childhood maltreatment would have a higher likelihood of a chronic pain diagnosis in their medical record. It was also expected that the relation between maltreatment type and chronic pain would be non-significant, given the role of prolonged stress exposure in the development of physical health problems, beyond individual maltreatment type. Further, the relation between maltreatment frequency and *acute* pain was tested, to differentiate whether maltreatment history was also linked to brief instances of pain that do not require multiple doctor visits, versus having a chronic pain condition. This relation was predicted to be non-significant.

Finally, the relation between maltreatment frequency and general chronic health condition, excluding pain diagnoses was explored. It was predicted that youth who reported more chronic maltreatment would be more likely to be diagnosed with another chronic health condition besides pain (e.g., asthma, obesity, diabetes), given these findings in prior studies. For example, one study found that exposure to chronic adversity before age 12 was associated with greater odds of a serious illness requiring medical attention in 12-year-old children (Flaherty et al. 2009). A sample of youth in foster care demonstrated high levels of various illnesses, including severe allergies, asthma, recurrent ear infections, and eczema (Jee et al. 2006).

Methods

Participants

Participants included 403 youth placed in foster care in a mid-sized Midwestern city. Participants ranged in age from 8 to 19 years, with a mean of 11.92 years ($SD = 5.81$). Forty-eight percent of the participants were female. The sample included 51% who endorsed their race/ethnicity as African American, 31% endorsed Caucasian, 12% endorsed multiracial, and 5% endorsed "other race" category. All participants had been in their current foster placement for at least 30 days (longest stay 24 months). All youth in foster care either resided in a group home/residential facility (44%) or a traditional foster home (56%) setting.

Participants were excluded if they were < 8 years of age, had lived in their current placement for <30 days, or had an Intelligence Quotient (IQ) of <70 as assessed by the Kauffman Brief Intelligence Test (KBIT). The cutoff of an IQ of 70 was used, as most measures for the study have not been validated in samples of youth with cognitive deficits.

Procedures

Participants were part of the Studying Pathways to Adjustment and Resilience in Kids (SPARK) project, which is a federally funded longitudinal project examining mental and physical health functioning in youth following abuse, neglect, and negative life events. Recruitment of participants included a range of strategies such as advertisement of the project on foster care list serves and in regional foster care newsletters, mailings and phone calls to eligible foster families, referrals from prior SPARK participants, and flyers given to newly trained foster parents. Eligible youth at residential facilities were invited in person to participate in the project. Consent was obtained from the state social service agency, serving as the children's legal guardian. Further, all participants and their caregivers received information about the study, the voluntary nature of participation, and limits to confidentiality before provision of informed consent and assent at the start of each data-collection meeting. The authors' university institutional review board and the State Department of Family Services review board provided approval for the study.

The SPARK project collected data at three time points across approximately 6 months; the current study used data from the first time point. Data collection occurred in private rooms at community locations (e.g., local libraries, community centers, and residential facilities) convenient to the foster families and youth participants. After completing the consent/assent forms, youth provided self-report on maltreatment and negative life event history. Data on medical history, including chronic pain diagnoses, were obtained via chart review of the official Medicaid record.

For the current study, youth provided answers with the assistance of an audio-computer-assisted self-interview (A-CASI) program on a laptop computer. Questions were read aloud to youth through the A-CASI program. Youth completed all study questions through the A-CASI system, with the exception of the KBIT, which was administered by research staff face-to-face. The A-CASI helps to maximize autonomy and confidentiality through the use of headphones while also accommodating participants who may need auditory cues to assist with reading. The A-CASI session was supervised by clinical child psychology doctoral trainees, and youth participants were offered numerous breaks, snacks, and water to promote their ability to focus and remain on task during data collection.

Each data collection session concluded with a thorough debriefing to assess for and manage changes in mood related to participation. The A-CASI was also reviewed for suicidal ideation and current abuse before dismissing each participant from data collection. Youth compensated for their participation. Care was taken to ensure thorough debriefing and follow-up. In addition to a standardized debriefing process at the end of each data collection, a follow-up phone call was initiated within 48 h to ensure the participant continued to maintain appropriate emotional well-being. See Jackson et al. (2012) for further details related to the methodology and procedures of the project.

Measures

Demographics Caregivers completed demographics on the youth participants (i.e., date of birth, age, gender, race/ethnicity).

Maltreatment History of maltreatment was assessed via youth self-report at the first time point, as well as through child protective services record review. In terms of record review, maltreatment from each case file was coded using the Modified Maltreatment Classification System (MMCS; English and Longscan Investigators 1997), which is a revised version of the Maltreatment Classification System (MCS; Barnett et al. 1993). The MCS has demonstrated reliability and validity in operationalization of maltreatment experiences (Bolger and Patterson 2001). Further, English and colleagues (English et al. 2005) and Litrownik and colleagues (Litrownik et al. 2005) utilized the MMCS system to conduct a study evaluating the impact of frequency and severity of maltreatment on outcomes, and both studies provided results indicating that this formulation of maltreatment was adequate in predicting emotional and behavioral outcomes in youth.

To code case files using the MMCS, the coder first determines the maltreatment type for each event or episode specified in the case file report. The broad categories of maltreatment in the MMCS are physical abuse, sexual abuse, physical neglect (failure to provide food, shelter, clothing, hygiene, or medical care), supervisory neglect (general lack of supervision, inappropriate substitute care, or lack of supervision in a dangerous environment), emotional/psychological maltreatment, moral-legal/educational maltreatment, and parental drug/alcohol use. For a complete review on the case file coding method used in the SPARK project, see Huffhines et al. (2016). For the current study, maltreatment events were counted and totaled to create the "maltreatment frequency" variable.

Self-report of maltreatment was also based on the MMCS, as used in the landmark LONGSCAN study (Knight et al. 2000). The MMCS self-report assesses four primary forms of maltreatment: physical abuse (e.g., "about how often did someone kick or punch you"; 18 items), psychological abuse (e.g., "about how often has anyone threatened to hurt someone very important to you"; 26 items), sexual abuse (e.g., "about how often did someone touch your private parts or bottom in some way"; 12 items), and neglect (e.g., "about how often did your parents give you enough to eat"; 24 items), in line with the type and severity coding of the MMCS. For this study, maltreatment frequency was calculated by summing the items endorsed by the youth within all four categories.

Chronic Pain All participants were enrolled in Medicaid as their primary medical provider. To determine the medical history of the youth, the Medicaid claims record for each child was provided by the state welfare agency to the investigators. Each child's history of medical diagnoses, medical visits, and medical hospitalizations was recorded. The type of medical diagnosis was used to determine whether the child experienced chronic pain. For the present study, only pain diagnoses that occurred within a 1-year window (3 months before enrollment in SPARK and 9 months beyond enrollment in SPARK) were evaluated. This was to ensure that maltreatment exposure occurred prior to pain diagnosis. A pain diagnosis that occurred only once in the medical record was classified as acute, as were pain diagnoses that occurred more than one time but did not last longer than two months. For example, if a physician diagnosed a child with a headache, and then a month later the child was again diagnosed with a headache, and those were the only pain diagnoses that year, this would be considered acute. In addition, if a child received a pain diagnosis along with another diagnosis that clearly caused

pain (e.g., a broken arm), this pain diagnosis was not included in the acute or chronic classifications. If a child received three or more pain diagnoses within a three-month span or longer, this was classified as chronic pain. A child could have multiple chronic pains, such as stomachache and backache, but there would have to be at least three months of the same pain type to be classified as chronic.

General Chronic Health Condition Youths' Medicaid claims records were used to determine the presence of a chronic health condition excluding a pain diagnosis or an acute condition. A systematic review on defining chronic health conditions in childhood was used to operationalize coding (Van Der Lee et al. 2007). The review found that a large range of definitions were in use, of which four were cited by many authors. Van Der Lee and colleagues concluded that the most comprehensive definition should include three components: 1) the condition is included in the International Statistical Classification of Diseases 10th revision (ICD-10) to ensure that the disease can be diagnosed according to professional standards, 2) the expected duration of the disease is at least three months, or impossibility of a cure has been established, and 3) the condition is associated with limitations in ordinary activities, such as attending school or participating in extracurricular activities or sports regularly, doing schoolwork, requires frequent attention from a doctor or health professional, and requires regular use of medications.

Thus, participants were classified as "having a chronic health condition" if they had an ICD-10 diagnosis that was indicated in the medical record as lasting for three months or longer, either as an ongoing diagnosis across multiple visits or by receiving medication prescriptions for the diagnosis lasting three months or longer. If participants did not meet these criteria, or only had chronic pain or acute diagnoses (such as a broken leg or a sinus infection) they were classified as "not having a chronic health condition." Chronic medical conditions within the medical record included asthma, obesity, hyperlipidemia, hypertension, dysmetabolic syndrome, a chronic heart problem (e.g., congenital heart anomaly requiring treatment, first degree atrioventricular block, sinoatrial node dysfunction), epilepsy, hypothyroidism, sleep apnea, type 2 diabetes, cystic fibrosis, chronic pancreatitis, and chronic non-alcoholic liver disease. Like chronic pain coding, only medical diagnoses that first occurred within a 1-year window (3 months before enrollment in SPARK and 9 months beyond enrollment in SPARK) were evaluated. However, for certain chronic conditions, such as cystic fibrosis and epilepsy, it is possible and even likely that these diagnoses occurred earlier in the child's life, but records from early childhood were not always included in the current medical record.

Data Analytic Plan

A binomial logistic regression was performed to ascertain the effects of age, gender, foster placement type, and maltreatment frequency on the likelihood that participants have chronic pain. Linearity of the continuous variables with respect to the logit of the dependent variable was assessed via the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all terms in the model resulting in statistical significance being accepted when $p < .01$ (Tabachnick and Fidell 2007). Based on this assessment, all continuous independent variables were found to be linearly related to the logit of the dependent variable.

Results

Frequencies of chronic pain, acute pain, and other chronic health conditions in the sample are presented in Table 1.

First, a model including self-reported maltreatment frequency and chronic pain was examined, adjusting for child age, gender, race, and foster placement. The logistic regression model was statistically significant, $\chi 2(9) = 21.35$, p ;= 0.010. The model explained 18% (Nagelkerke R2) of the variance in chronic pain. Results showed a dose-response relation, wherein youth who experienced more maltreatment events had significantly greater odds of chronic pain (see Table 2). A model including case file report of maltreatment frequency and chronic pain was also examined, adjusting for child age, gender, race, and foster placement. The logistic regression model was statistically significant, $\chi 2(8) = 56.77$, $p = 0.054$. The model explained 12% (Nagelkerke R2) of the variance in chronic pain. Results indicated that those with no maltreatment exposure in their case file records had the lowest odds of chronic pain, while those with the most maltreatment events in their case file records had the greatest odds of chronic pain. However, results did not indicate a clear dose-response relation (see Table 3).

Next, to determine whether frequency within each maltreatment type was associated with greater odds of chronic pain, a model including the four types of maltreatment (physical abuse, sexual abuse, psychological abuse, and neglect) was examined using both self-report and case file report of maltreatment. None of the four maltreatment types were significantly associated with chronic pain in either the self-report or case file report models (as shown in Tables 4 and 5).

Then, to determine whether maltreatment frequency is associated with acute pain, additional models using self-report and case file report of maltreatment were examined. It was found that maltreatment frequency was not associated with greater odds of acute pain either in self-report or case file report models (as shown in Tables 6 and 7).

Table 1 Frequency statistics for all health conditions ($N = 403$)

Pain conditions	Frequency (%)
Chronic pain	21 (5.2)
Acute pain	19 (4.7)
Other chronic conditions	Frequency (%)
Total chronic conditions excluding pain	105 (25.7)
Asthma	40 (9.9)
Obesity	24 (6.0)
Hyperlipidemia, hypertension, or dysmetabolic syndrome	10 (2.4)
Chronic heart problem	11 (2.6)
Epilepsy	6 (1.5)
Hypothyroidism	5 (1.2)
Sleep apnea	3 (0.7)
Type 2 diabetes	2 (0.5)
Cystic fibrosis	2 (0.5)
Chronic pancreatitis	1 (0.2)
Chronic non-alcoholic liver disease	1 (0.2)

Finally, models testing whether maltreatment frequency was associated with general chronic health condition (e.g., asthma, diabetes, obesity, cystic fibrosis), excluding chronic and acute pain, were tested, and found to be non-significant in both self-report and case file report conditions (as shown in Tables 8 and 9).

Discussion

The current study provides detailed information on how exposure to maltreatment affects the likelihood of a chronic pain diagnosis among youth who are placed in foster care. This type of data is important for professionals working to understand, prevent, and treat the effects of maltreatment, as well as for those endeavoring to understand, prevent, and treat chronic pain. This study was the first to examine the link in a sample of youth in foster care. In both past and recent research, a history of child maltreatment has been shown to be associated with chronic pain conditions in adults. The present work adds to this growing literature demonstrating an association between maltreatment frequency and chronic pain in a youth sample.

The results indicate that among youth placed in foster care, those who self-reported more frequent maltreatment (i.e., a greater number of different maltreatment events across types) had a significantly higher likelihood of experiencing chronic pain, in a dose-response fashion. Specifically, those with 1–10 maltreatment events had the lowest odds of chronic pain, followed by those with 11–20 maltreatment events, then 21–30, 31–40, 41–50, and finally 51–60 with the highest odds. Age, gender, race, and type of foster placement did not affect likelihood of chronic pain diagnosis. This finding provides evidence for the theory that chronic activation of the stress response system may result in changes in physiology, and thus subsequent health problems (Miller et al. 2011; Nusslock and Miller 2016). Whether the youth is a child or adolescent, boy or girl, or residing in a foster home or residential/group home, does not significantly increase the odds of a chronic pain diagnosis.

Previous research has found that self-report of maltreatment may be more related to mental health outcomes than is case file report of maltreatment (Hambrick et al. 2014). The current study similarly compared pain and other health outcomes between self- and case file report. Although youth with more frequent maltreatment reported in their case file also had greater odds of chronic pain, results did not follow a clear dose-response pattern. Importantly, 26.4% of the sample had no maltreatment listed in their case file at all (refer to Table 3). Rather, these youth were placed in foster care due to reasons other than substantiated maltreatment that occurred to them personally; for example, many youth in our sample had reports of drug-exposed infant siblings, maltreatment to siblings, or parental arrests. However, it may be misleading to classify these youth as having "no maltreatment" as all resided with risky families and were placed in foster care. This may

Table 2 Adjusted odds ratios for chronic pain by self-report maltreatment frequency score ($N = 403$)

Maltreatment frequency score	N	%	OR (95% CI)
1–10	146.69	36.4	**1.15** (1.02–1.32)
11–20	139.84	34.7	**1.62** (1.31–2.04)
21–30	65.69	16.3	**2.56** (1.43–4.55)
31–40	32.64	8.1	**3.06** (2.40–3.92)
41–50	14.51	3.6	**4.86** (4.30–5.47)
51–60	3.63	0.9	**5.01** (3.71–6.03)
M for maltreatment events = 16.65; *SD* = 11.13; Range = 1–60			

Odds ratios adjusted for child age, sex, race, and foster placement. Boldface indicates statistical significant ($p < .05$)

Table 3 Adjusted odds ratios for chronic pain by case file report maltreatment frequency score ($N = 403$)

Maltreatment frequency score	N	%	OR (95% CI)
0	146.69	26.4	**1.10** (1.01–1.26)
1–10	139.84	43.4	**1.63** (1.29–1.75)
11–20	65.69	24.6	**1.41** (1.13–1.67)
21–30	32.64	4.2	**2.84** (2.07–3.14)
31–40	14.51	.8	**2.89** (2.10–3.20)
M for maltreatment events = 7.45; *SD* = 7.25; Range = 0–40			

Odds ratios adjusted for child age, sex, race, and foster placement. Boldface indicates statistical significant ($p < .05$)

Table 4 Adjusted odds ratios for chronic pain by self-report maltreatment type ($N = 403$)

Maltreatment Type	N	%	OR (95% CI)
Physical abuse	373	92.6	1.39 (.74–2.62)
Sexual abuse	187	46.4	1.19 (.88–1.61)
Psychological abuse	386	95.8	1.12 (.61–2.05)
Neglect	297	73.7	.95 (.63–1.45)

Odds ratios adjusted for child age, sex, race, and foster placement. Boldface indicates statistical significant ($p < .05$)

explain why youth with no maltreatment in their case files still had significant odds of chronic pain. The lack of dose-response relation may also speak to the misclassification of maltreatment exposure, wherein a case file might list 11 maltreatment events, but a youth actually experienced more. In sum, results based on case file report contribute evidence to the relation between maltreatment and chronic pain but may not be as accurate as self-report.

The majority of youth pain research is conducted with individuals presenting at a pain clinic, yet research has shown that only 2 % of pain sufferers ever attend a pain clinic, and most pain cases are managed in primary care, if anywhere (Van Hecke et al. 2013). The current methodology consisted of a sample with much higher maltreatment exposure rates than are typically found in a pain clinic, and although they met with a medical professional, may have included youth who would likely never be present at a specialty clinic.

In addition to the finding that self- and case file report of maltreatment frequency was associated with a chronic pain diagnosis, several other models were examined. A model examining acute pain was investigated to provide additional evidence to the theory that maltreatment results in severe and detrimental health problems, not just general health problems that warrant a doctor's visit, such as the occasional headache. The results indicate that in fact, maltreatment frequency was unrelated to an acute pain diagnosis. This finding is line with the theories posited by Miller and colleagues (Miller et al. 2011) and Nusslock and Miller (2016), that exposure to prolonged stress, such as frequent maltreatment, leads to severe, oftentimes lifelong health problems. The data showed

Table 5 Adjusted odds ratios for chronic pain by case file report maltreatment type ($N = 403$)

Maltreatment Type	N	%	OR (95% CI)
Physical abuse	276	68.5	1.99 (.89–2.62)
Sexual abuse	154.75	38.4	0.90 (.88–1.61)
Psychological abuse	192.63	47.8	1.27 (.61–2.05)
Neglect	276.86	68.7	1.33 (.75–1.50)

Odds ratios adjusted for child age, sex, race, and foster placement. Boldface indicates statistical significant ($p < .05$)

Table 6 Adjusted odds ratios for acute pain by self-report maltreatment frequency score ($N = 403$)

Maltreatment frequency score	N	%	OR (95% CI)
1–10	146.69	36.4	0.43 (0.02–1.00)
11–20	139.84	34.7	0.55 (0.27–1.04)
21–30	65.69	16.3	0.33 (0.15–1.01)
31–40	32.64	8.1	0.60 (0.40–3.92)
41–50	14.51	3.6	0.41 (0.07–1.11)
51–60	3.63	0.9	0.47 (0.13–2.06)

Odds ratios adjusted for child age, sex, race, and foster placement. Boldface indicates statistical significant ($p < .05$)

that youth who had experienced frequent maltreatment had no higher odds compared to youth who experienced less frequent trauma of having an acute pain diagnosis.

In addition, given numerous studies linking maltreatment exposure to various chronic health conditions, beginning with the Adverse Childhood Experiences (ACEs) study (Felitti et al. 1998), a model examining maltreatment frequency and presence of a chronic illness was also examined. Chronic and acute pain diagnoses were not included in the chronic health condition definition, so that the results would reflect other illnesses beyond the established pain relationship. Maltreatment frequency was not significantly associated with presence of a chronic health condition in the youth sample. The majority of research on maltreatment and chronic health conditions has focused on adults. It may be that youth have not yet had time to develop the chronic health conditions that are largely associated with maltreatment, such as heart disease. Interestingly, it was only chronic pain that emerged as a significant outcome in youth.

The present study has several important clinical implications. Improving our understanding of the factors associated with chronic pain will better inform our prevention efforts, as well as clinical management of pain conditions in youth, ultimately leading to more days present at school, improved family relationships, and better mental health (Van Hecke et al. 2013). Research on the mechanisms contributing to chronic pain bring the possibility of new treatments. However, two-thirds of patients report dissatisfaction with treatment for their chronic

Table 7 Adjusted odds ratios for acute pain by case file report maltreatment frequency score ($N = 403$)

Maltreatment frequency score	N	%	OR (95% CI)
0	146.69	26.4	0.60 (0.40–0.88)
1–10	139.84	43.4	0.51 (0.13–0.91)
11–20	65.69	24.6	1.22 (0.99–1.45)
21–30	32.64	4.2	0.84 (0.39–1.02)
31–40	14.51	.8	0.87 (0.70–1.10)

Odds ratios adjusted for child age, sex, race, and foster placement. Boldface indicates statistical significant ($p < .05$)

Table 8 Adjusted odds ratios for general chronic health condition by self-report maltreatment frequency score ($N = 403$)

Maltreatment frequency score	N	%	OR (95% CI)
1–10	146.69	36.4	0.43 (0.02–1.00)
11–20	139.84	34.7	0.69 (0.41–1.44)
21–30	65.69	16.3	0.14 (0.06–1.04)
31–40	32.64	8.1	0.78 (0.33–1.26)
41–50	14.51	3.6	1.21 (0.84–1.65)
51–60	3.63	0.9	1.01 (0.79–1.18)

Odds ratios adjusted for child age, sex, race, and foster placement. Boldface indicates statistical significant ($p < .05$)

pain, and report that it persists for many years (Elliott et al. 2002). One possibility is that underlying causes are not treated, such as symptoms related to past childhood maltreatment. Some research has found that medications alone are rarely effective for long-term pain management, and that the most successful programs combine lifestyle, behavioral, cognitive, and social techniques (Kendall-Tackett 2001). Child maltreatment may affect individuals in all of these areas. Clinicians who understand that there is an increased risk for chronic pain conditions among individuals exposed to maltreatment, and that more frequent maltreatment increases the likelihood of a diagnosis, may be more likely to assess for maltreatment history, and then provide more appropriate treatment, perhaps targeting the child maltreatment itself. Moreover, professionals who are working with youth exposed to maltreatment may do well to ask about pain given the link between the two variables and help guide youth towards appropriate health care.

Limitations

The study has several important limitations. First, it was not possible to pinpoint exact timing of maltreatment exposure and chronic pain onset. Although chronic pain diagnoses were limited to those occurring within the one-year period of the study, after children had already been placed in foster care, thus ensuring that the maltreatment occurred prior to the pain diagnoses, it is possible that youth experienced chronic pain earlier than this period, or before maltreatment occurred. It is also possible that maltreatment at different time periods, such as early childhood or most recently, affect chronic pain differently and it was not possible to know the exact age when the maltreatment occurred. Second, the sample had relatively low levels of chronic pain, thus this phenomenon may be better understood in a larger sample with higher rates of chronic pain conditions.

Third, the analyses included pain diagnoses present in the Medicaid claims records, but no measures of pain severity or activity interference, as these were not available in the medical records. This prevented knowing whether maltreatment chronicity affects certain aspects of pain differently. This will be an important topic for future research. In addition, there are other factors that may have contributed to a child seeing a physician, and thus having a visit included in the medical record, such as a foster caregiver receiving instructions from a social worker to take the child to the doctor, the caregivers' level of medical knowledge, the child's age, or the presence of other medical conditions. Given the strict criteria for classifying pain as a chronic condition, however, this study is more likely to err on the side of under-diagnosing chronic pain than over-diagnosing. Finally, the present study included the often-understudied sample of youth in foster care, and thus, these results may not apply for maltreated youth not placed in foster care, or youth with lower levels of maltreatment exposure.

Table 9 Adjusted Odds Ratios for General Chronic Health Condition by Self-Report Maltreatment Frequency Score (N = 403)

Maltreatment Frequency Score	N	%	OR (95% CI)
0	146.69	26.4	0.11 (0.01–1.09)
1–10	139.84	43.4	0.43 (0.27–1.00)
11–20	65.69	24.6	0.32 (0.21–1.05)
21–30	32.64	4.2	1.65 (0.95–2.04)
31–40	14.51	.8	1.85 (1.00–2.63)

Odds ratios adjusted for child age, sex, race, and foster placement. Boldface indicates statistical significant ($p < .05$)

Conclusion

In summary, the current research has demonstrated that maltreatment frequency exposure across maltreatment types (i.e., physical, sexual, and psychological abuse; neglect) is associated with an increase in the risk of a chronic pain diagnosis in a sample of youth in foster care. This is not the case for acute pain diagnoses or general chronic health condition excluding pain. To prevent the negative long-term health consequences of childhood maltreatment, future research should study the biological mechanisms underlying this relation. Future research should also examine the impact of timing of maltreatment exposure, and the impact of maltreatment exposure on pain severity and functioning. Youth exposed to maltreatment and placed in foster care should be screened for chronic pain by their primary care provider. Clinicians should assess for frequent maltreatment exposure particularly, rather than solely individual maltreatment type, to better inform treatment for chronic pain in youth.

Acknowledgements This research was supported by funding from the National Institutes of Mental Health, RO1 Grant MH079252-03 to Yo Jackson, Principal Investigator, as well as funding from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, F31 grant 1F31HD088020-01A1 awarded to Lindsay Huffhines.

Compliance with Ethical Standards

Disclosure of Interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical Standards and Informed Consent All participants and their caregivers received information about the study, the voluntary nature of participation, and limits to confidentiality before provision of informed consent and assent at the start of each data-collection meeting. The authors' university institutional review board and the State Department of Family Services review board provided approval for the study.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

References

Anda, R., Tietjen, G., Schulman, E., Felitti, V., & Croft, J. (2010). Adverse childhood experiences and frequent headaches in adults. *Headache: The Journal of Head and Face Pain, 50*, 1473–1481.

Barnett, D., Manly, J. T., & Cicchetti, D. (1993). Defining child maltreatment: The interface between policy and research. In D. Cicchetti & S. L. Toth (Eds.), *Child Abuse, Child Development, and Social Policy* (pp. 7–73). Norwood: Ablex.

Bolger, K. E., & Patterson, C. J. (2001). Developmental pathways from child maltreatment to peer rejection. *Child Development, 72*, 549–568.

Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin, 98*, 310–357.

Dickerson, S. S., & Kemeny, M. E. (2004). Acute stressors and cortisol responses: A theoretical integration and synthesis of laboratory research. *Psychological Bulletin, 130*, 355–391.

Elliott, A., Smith, B., Hannaford, P., Smith, W., & Chambers, W. (2002). The course of chronic pain in the community: Results of a 4-year follow-up study. *Pain, 99*, 299–307.

English, D. J., & Longscan Investigators. (1997). Modified maltreatment classification system (MMCS). *For more information visit the LONGSCAN website at* http://www.iprc.unc.edu/longscan. Accessed 4 Sept 2014.

English, D. J., Graham, J. C., Litrownik, A. J., Everson, M., & Bangdiwala, S. I. (2005). Defining maltreatment chronicity: Are there differences in child outcomes? *Child Abuse & Neglect, 29*, 575–595.

Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., et al. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: The adverse childhood experiences (ACE) study. *American Journal of Preventive Medicine, 14*, 245–258.

Flaherty, E. G., Thompson, R., Litrownik, A. J., Zolotor, A. J., Dubowitz, H., Runyan, D. K., English, D. J., & Everson, M. D. (2009). Adverse childhood exposures and reported child health at age 12. *Academic Pediatrics, 9*, 150–156.

Glaser, R., & Kiecolt-Glaser, J. K. (2005). Stress-induced immune dysfunction: Implications for health. *Nature Reviews Immunology, 5*, 243–251.

Green, C. R., Flowe-Valencia, H., Rosenblum, L., & Tait, A. R. (2001). The role of childhood and adulthood abuse among women presenting for chronic pain management. *The Clinical Journal of Pain, 17*, 359–364.

Hambrick, E. P., Tunno, A. M., Gabrielli, J., Jackson, Y., & Belz, C. (2014). Using multiple informants to assess child maltreatment: Concordance between case file and youth self-report. *Journal of Aggression, Maltreatment & Trauma, 23*, 751–771.

Hostinar, C. E., Sullivan, R. M., & Gunnar, M. R. (2014). Psychobiological mechanisms underlying the social buffering of the HPA axis: A review of animal models and human studies across development. *Psychological Bulletin, 140*, 1–47.

Huffhines, L., Tunno, A. M., Cho, B., Hambrick, E. P., Campos, I., Lichty, B., & Jackson, Y. (2016). Case file coding of child maltreatment: Methods, challenges, and innovations in a longitudinal project of youth in foster care. *Children and Youth Services Review, 67*, 254–262.

Imbierowicz, K., & Egle, U. T. (2003). Childhood adversities in patients with fibromyalgia and somatoform pain disorder. *European Journal of Pain, 7*, 113–119.

Jackson, Y., Gabrielli, J., Tunno, A. M., & Hambrick, E. P. (2012). Strategies for longitudinal research with youth in foster care: A demonstration of methods, barriers, and innovations. *Children and Youth Services Review, 34*, 1208–1213.

Jee, S. H., Barth, R. P., Szilagyi, M. A., Szilagyi, P. G., Aida, M., & Davis, M. M. (2006). Factors associated with chronic conditions among children in foster care. *Journal of Health Care for the Poor and Underserved, 17*, 328–341.

Jones, G. T., Power, C., & Macfarlane, G. J. (2009). Adverse events in childhood and chronic widespread pain in adult life: Results from the 1958 British birth cohort study. *Pain, 143*, 92–96.

Kendall-Tackett, K. (2001). Chronic pain: The next frontier in child maltreatment research. *Child Abuse & Neglect, 25*, 997–1000.

King, S., Chambers, C. T., Huguet, A., MacNevin, R. C., McGrath, P. J., Parker, L., & MacDonald, A. J. (2011). The epidemiology of chronic pain in children and adolescents revisited: A systematic review. *Pain, 152*, 2729–2738.

Knight, E. D., Runyan, D. K., Dubowitz, H., Brandford, C., Kotch, J., Litrownik, A., & Hunter, W. (2000). Methodological and ethical challenges associated with child self-report of maltreatment: Solutions implemented by the LongSCAN consortium. *Journal of Interpersonal Violence, 15*, 760–775.

Kopec, J. A., & Sayre, E. C. (2005). Stressful experiences in childhood and chronic back pain in the general population. *The Clinical Journal of Pain, 21*, 478–483.

Lampe, A., Doering, S., Rumpold, G., Sölder, E., Krismer, M., Kantner-Rumplmair, W., Schubert, C., & Söllner, W. (2003). Chronic pain syndromes and their relation to childhood abuse and stressful life events. *Journal of Psychosomatic Research, 54*, 361–367.

Litrownik, A. J., Lau, A., English, D. J., Briggs, E., Newton, R. R., Romney, S., & Dubowitz, H. (2005). Measuring the severity of child maltreatment. *Child Abuse & Neglect, 29*, 553–573.

Merskey, H., & Bogduk, N. (1994). *Classification of chronic pain: Descriptions of chronic pain syndromes and definitions of pain terms. International Association for the Study of Pain*. Seattle: IASP Press.

Miller, G. E., Chen, E., & Zhou, E. S. (2007). If it goes up, must it come down? Chronic stress and the hypothalamic-pituitary-adrenocortical axis in humans. *Psychological Bulletin, 133*, 25–45.

Miller, G. E., Chen, E., & Parker, K. J. (2011). Psychological stress in childhood and susceptibility to the chronic diseases of aging: Moving towards a model of behavioral and biological mechanisms. *Psychological Bulletin, 137*, 959–997.

Nusslock, R., & Miller, G. E. (2016). Early-life adversity and physical and emotional health across the lifespan: A neuroimmune network hypothesis. *Biological Psychiatry, 80*, 23–32.

Palermo, T. M., Valrie, C. R., & Karlson, C. W. (2014). Family and parent influences on pediatric chronic pain: A developmental perspective. *American Psychologist, 69*, 142.

Segerstrom, S. C., & Miller, G. E. (2004). Psychological stress and the immune system: A meta-analytic study of 30 years of inquiry. *Psychological Bulletin, 130*, 601–630.

Shonkoff, J. P., Garner, A. S., Siegel, B. S., Dobbins, M. I., Earls, M. F., McGuinn, L., … Committee on Early Childhood, Adoption, and Dependent Care. (2012). The lifelong effects of early childhood adversity and toxic stress. *Pediatrics, 129*, e232–e246.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics*. Boston: Allyn & Bacon/Pearson Education.

Van Der Lee, J. H., Mokkink, L. B., Grootenhuis, M. A., Heymans, H. S., & Offringa, M. (2007). Definitions and measurement of chronic health conditions in childhood: A systematic review. *JAMA, 297*, 2741–2751.

Van Hecke, O., Torrance, N., & Smith, B. H. (2013). Chronic pain epidemiology and its clinical relevance. *British Journal of Anaesthesia, 111*, 13–18.