Quantifying the influence of child abuse history on the cardinal symptoms of fibromyalgia

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ABSTRACT

Objective. *To quantify the influence of abuse, particularly in childhood, with pain sensitivity and other adverse symptoms experienced by women with fibromyalgia (FM).*

Methods. *Subjects with FM completed a detailed abuse interview, dolorimetry, and questionnaire-based assessments of fatigue, cognitive self-appraisal, and depression. Student's t- and chi-square tests were used to analyse differences in FM symptoms between those with and without a history of childhood abuse. Linear regression was used to evaluate the relationship between abuse and symptom severity, adjusting for possible confounders.*

Results. *In 111 women with FM, physical abuse during childhood demonstrated a clinically modest, yet statistically significant, association with increased tenderness as measured by pain pressure thresholds (β=-0.25, p=0.011) and tender points (β=0.23, p=.022). Physical child abuse was also associated with cognitive language impairment after adjusting for depression (β=0.27, p=0.001). While emotional child abuse was associated with fatigue, the association did not persist after adjustment for depressive symptoms.*

Conclusion. *Group differences are of small magnitude and might not directly impact clinical practice, however, the experience of child abuse is associated with FM symptom severity and may shape the biological development of interoception in ways that predispose to pain and polysymptomatic distress.*

Introduction

Fibromyalgia (FM) is a chronic, somatoform illness characterised by widespread pain and tenderness (1, 2). FM is currently classified by chronic pain (≥3 months duration) in multiple body regions, fatigue, cognitive impairment, and sleep disturbance (3, 4). Further, there is a high prevalence of mood disturbance, particularly depression, in FM (5).

Although various neurobiological processes such as central sensitisation have been proposed to underlie FM symptoms, it is clear that personal experiences and beliefs as well as sociocultural factors powerfully influence pain perception (6, 7). A German population study demonstrated that self-report of psychosocial stress positively correlated with meeting FM criteria (8). Individuals with FM report higher physical and emotional abuse compared with rheumatoid arthritis patients and healthy individuals (9). A recent meta-analysis found that women who experienced trauma were 2.7 times more likely than women who had no trauma history to have functional somatic syndromes, including FM (10). A history of physical or sexual abuse has been associated with increased pain sensitivity and fatigue in FM patients (11). Furthermore, a prior cluster analysis of women with FM identified that psychosocial stressors, including childhood abuse, cluster with severe symptom profile and biochemical markers of stress (12). Recent research has demonstrated that the association between the psychosocial distress of childhood abuse and those with FM is consistent even across cultures (13).

Trauma at any time in one's life can create psychological and social stress, however, children may be particularly vulnerable to environmental and psychosocial influences. For example, a study of Post-Traumatic Stress Disorder (PTSD) demonstrated that abuse in childhood had much greater influence on symptom complexity than abuse in adulthood (14). Similarly, childhood trauma may influence the course of somatosensory maturation, predisposing the individual to future somatic distress as an adult. Childhood adversity has

been associated with an increased allostatic load and an adverse health profile both in childhood and adulthood (15-17). In a cross-sectional study of a heterogeneous sample of adult outpatients, childhood trauma was a significant predictor of subjective pain report and pain catastrophisation (18). Painful experiences in neonatal life have been associated with increased pain sensitivity and FM (19). In a study of 18,675 adults, childhood abuse was the most significant predictor of chronic fatigue after controlling for sociodemographic factors (20). These studies suggest that early life trauma influences the symptom profile of FM (13).

Though there is evidence that abuse history is associated with FM, there is a lack of evidence associating child abuse history with symptom severity or profile. Here, we provide the first exploration of the influence of abuse history on dolorimetric measures of pain sensitivity and subjective symptoms. Our primary aim was to quantify the association between self-reported child abuse and measurements of pain sensitivity in adult women with FM. Our secondary aim was to quantify the association of self-reported child abuse with the other cardinal symptoms of FM (*i.e.* fatigue, cognitive impairment, sleep disturbances, and depressed mood) (21-26). Estimating the clinical impact of abuse on FM symptoms may prompt further investigations into the psychological and biological underpinnings of FM.

Methods

Participants

All participants were part of a fibromyalgia, natural history study approved by the MedStar Health Institutional Review Board. Women diagnosed with FM using the 1990 or the 2010 American College of Rheumatology criteria and the Widespread Pain Index (WPI) were included in the analyses (4, 27). Since there was a skewed distribution of the number of men and women in the study, as there were only 13 men studied and none with a history of abuse of any kind, only women were included for analysis. Participants were asked if they had experienced any abuse in their lifetime and a detailed abuse history was obtained by a single physician interviewer (BW), which included age at the time of abuse and type of abuse, which was characterised as emotional, physical, or both as determined by the clinician interviewer. Physical and emotional abuse was then categorised as an event in childhood, if the event occurred before age 18, or adulthood, including spousal abuse. Reported experiences of rape were coded as physical abuse. The abuse interview was part of a 90 minute standardised initial fibromyalgia research clinic intake assessment.

Measures/Procedures

• *Dolorimetry*

Objective pain measures were obtained by dolorimetric assessment using an algometer at each of 18 tender points. Two outcome measures included average tender point pain pressure threshold (PPT) in kg/cm^2 and the total number of tender points below the 4 kg/cm^2 threshold (27). Trained research nurses performed the dolorimetric measurements. Tender point counts were measured by a single physician (BW). The greatest sensitivity and specificity for identifying an improvement in pain as "somewhat better" or greater is a change in dolorimetric pain pressure threshold ranging from a 0.51 kg/cm^2 to 0.85 kg/cm^2 threshold increase in musculoskeletal pain patients (28). The findings of a prior fibromyalgia clinical trial suggested a minimally clinically important difference (MCID) for tender point pain threshold of 0.3 kg/cm^2 (29).

• *Multidimensional Fatigue Inventory (MFI)*

The MFI is a reliable and valid measure of fatigue severity that provides subscales of general fatigue, physical fatigue, reduced activity, reduced motivation and mental fatigue (Cronbach's alpha=0.84) (30). The MFI is scored on a scale of 4–20 with higher scores representing more severe symptoms. There is no proposed MCID cut-off with the MFI. Patients enrolled in fibromyalgia clinical trials typically have MFI scores of approximately 14 (31). In this study, we report scores in terms of "general", "physical", "mental", "motivation", and "activity" fatigue (30, 32).

• *Multiple Ability Self-Report Questionnaire (MASQ)*

The MASQ is a questionnaire designed to assess the self-perception of cognitive difficulties in contrast to the more traditional "objective" neuropsychological assessment by a clinician. The MASQ, which was found to be reliable (Cronbach's alpha=0.92) and has been used in a number of prior clinical studies of FM and its treatments (32-34), measures the perception of five domains: language, visual-perceptual ability, verbal memory, visual-spatial memory, and attention/concentration. The MASQ sub-scales are scored on a scale of 8–40 with higher scores indicating greater perceived difficulties. Although there is no proposed MCID cut-off with the MASQ, patients enrolled in a fibromyalgia research clinic typically have MASQ subscale scores of approximately 14 for visual-perceptual ability and 20 for the other subscales (34). In this study, we report scores in terms of "language", "visual/perception", "verbal memory", "visual/spatial", and "attention/concentration".

• *Brief Pain Inventory (BPI)*

The BPI is a reliable (Cronbach's alpha between 0.85-0.88) and valid (r=0.69-0.81 correlation with other pain scales) measurement of multiple, clinically relevant aspects of pain (32, 35). The BPI provides two summary scores, pain severity and pain interference. Both are scored on 0–10 scales, with higher scores indicating more severe pain. Patients enrolled in fibromyalgia clinical trials typically have BPI scores of about 6 (31). A 2–3 point change is typically considered the minimally clinical important difference (MCID) in pain (32, 36). In this study, we report scores in terms of "pain severity" and "pain interference".

• *Sleep quality*

The 2010 American College of Rheumatology criteria for FM contains a Symptom Severity Index (SSS). The SSS includes a severity scale (from 0–3) for symptoms including: fatigue, waking unrefreshed, and cognitive symptoms. In this study, we utilised scores from the "waking unrefreshed" subscore to assess subjective sleep quality.

• *Hospital Anxiety and Depression Scale (HADS)*
This scale assesses mood symptoms by self-reported response to 14 items. These items are grouped to yield both an anxiety (HADS-A, Cronbach's alpha=0.68–0.93) and depression (HADS-D, Cronbach's alpha=0.67–0.90) score (37). The HADS has been validated against other common mood questionnaires (r=0.49–0.83). Though scores for each scale can range from 0–21, a total of at least 8 or above on either score is considered the cut off for anxiety or depression, respectively (37). In this study, we report scores in terms of "HADS-A" and "HADS-D".

• *Pain Catastrophisation Scale (PCS)*
The PCS is a 13-item questionnaire that assesses beliefs that pain is worse than it actually is because of helplessness, rumination, or magnification, for which there is a subscale for each (38). Each item is scaled from 0–4 with total scores ranging from 0–52, with a range of 0–24 for helplessness, 0–16 for rumination, and 0–12 for magnification (38). In a prior study using the PCS in FM patients Cronbach's alpha was 0.98 (18). In this study, we report scores in terms of total PCS, helplessness, rumination, and magnification.

Statistical analyses
Clinical characteristic group differences were examined using *t*-tests. Linear regression was used to assess variables that showed group differences on univariate analysis. Dependent variables included average tender point pain pressure threshold (kg/cm^2), the number of tender points below a 4 kg/cm^2 pressure threshold, MFI scores, MASQ domains, and unrefreshed waking (WPI). Given that this is a hypothesis generating study, no adjustment was made for multiple comparisons, but multivariate regression was used to adjust for possible confounders (39). No replacement values were assigned for missing data. For variables demonstrating a significant association with child abuse history, effect size was quantified between those with a history of abuse and those without and determined as small (0.1), medium (0.3) or large (0.5) by Cohen guidelines (40).

Table I. Subject demographics and clinical characteristics.

	Total sample (n=111) n (%)	Child abuse (n=42) n (%)	No child abuse (n=69) n (%)
Race			
White	65 (61.9)	26 (66.67)	39 (59.09)
Education			
≥College	79 (75.24)	31 (79.49)	48 (72.72)
Employment			
Employed	49 (50)	15 (41.67)	34 (54.84)
Marital Status			
Married	56 (54.9)	22 (59.46)	34 (52.31)
	Mean (SD)	Mean (SD)	Mean (SD)
Age	47.33 (10.98)	47 (10.61)	47.53 (11.28)
BMI	31.42 (9.11)	31.29 (8.30)	31.50 (9.67)
Average PPT (kg/cm^2)	2.95 (1.66)	2.54 (1.08)	3.18 (1.89)
Number of TPs<4 kg/cm^2 PPT	14.04 (4.78)	15.05 (3.01)	13.45 (5.49)
MFI			
General	16.82 (3.49)	17.81 (2.63)	16.21 (3.82)
Physical	15.32 (3.70)	16.29 (3.30)	14.74 (3.83)
Mental	14.55 (4.29)	15.61 (3.99)	13.91 (4.37)
Motivation	12.60 (4.12)	13.33 (4.08)	12.16 (4.10)
Activity	13.65 (4.51)	14.25 (4.45)	13.29 (4.54)
HADS			
Anxiety	9.05 (4.72)	9.51 (4.96)	8.77 (4.59)
Depression	7.60 (4.15)	8.70 (3.96)	6.92 (4.15)
PCS			
Total	20.84 (13.57)	23.28 (14.43)	19.37 (12.92)
Helplessness	9.44 (6.61)	10.90 (6.81)	8.54 (6.36)
Rumination	7.22 (4.73)	7.62 (5.27)	6.98 (4.40)
Magnification	4.13 (3.26)	4.60 (3.38)	3.85 (3.17)
BPI			
Pain severity	5.55 (2.13)	5.48 (1.90)	5.6 (2.26)
MASQ			
Language	19.41 (4.71)	20.90 (4.52)	18.46 (4.62)
Visual-Percep	14.90 (4.82)	15.87 (5.36)	14.31 (4.40)
Verbal-mem	22.19 (5.18)	23.26 (4.96)	21.49 (5.23)
Visual-spatial	17.97 (4.98)	18.98 (5.44)	17.35 (4.62)
Attention	22.13 (5.74)	23.13 (5.51)	21.51 (5.83)
WPI			
Unrefreshed	2.57 (3.13)	3.03 (5.02)	2.30 (.84)

SD: Standard Deviation; BMI: Body Mass Index; TP: Tender Point; PPT: Pain Pressure Threshold; MFI: Multidimensional Fatigue Inventory; HADS: Hospital Anxiety and Depression Scale; PCS: Pain Catastrophisation Scale; BPI: Brief Pain Inventory; MASQ: Multiple Ability Self-Report Questionnaire; Visual-percep: Visual-perceptual Ability; Verbal mem: Verbal memory; Visual-spatial: Visual-spatial memory; Attention: Attention/Concentration; WPI: Widespread Pain Index; Unrefreshed: waking unrefreshed.

Because of the significant overlap between depressive symptoms and the profile of other symptoms in FM (41), Pearson's correlation was used to assess the relationship between depression and all other symptoms. Depression was also used as a covariate for all measures in a linear regression model. Additionally, in the multivariate analysis for pain outcomes, given prior demonstration of a relationship between body mass index (BMI) and tenderness in FM (42), as well as the demonstration of a relationship between a history of abuse in FM patients and pain catastrophisation (18), both BMI and pain catastrophisation were used as covariates. The association of symptom severity and adult abuse was not a part of our a priori hypothesis in this study; however, given that there is a possible influence of abuse experienced in adulthood, we included a history of adult abuse as a potential covariate. Significance was considered at $p<0.05$, two-tailed. Statistical analysis was performed using IBM SPSS software, v. 21.

Results

Subjects
The majority of 111 women (age 47.33±10.98 years) were white

(61.9%), college graduates (75.24%), employed (50%), and married (54.9%) (Table I). A total of 42 women (37.8%) provided a self-reported history of any child abuse, with 14 reporting physical abuse, 15 reporting emotional abuse alone, and 14 reporting both emotional and physical abuse. Of the 24 women (21.6%) who self-reported abuse in adulthood, only 9 women also self-reported childhood abuse.

Pain sensitivity and child abuse

Of the total population (n=111), 106 women completed all of the study measurements. Mean subjective BPI pain severity score was 5.55±2.13. Mean pain pressure threshold was 2.95±1.66 kg/cm^2 with an average of 14.04±4.78 tender points above threshold. Table I shows the mean pain pressure thresholds for each abuse group. There was no difference in subjective pain as measured by BPI based on child abuse history. However, there was a significant difference in pain pressure threshold (t (104) =-1.92, p=0.030) and a trend in tender points counts (t (104) =1.94, p=0.055) by child abuse history. These findings became more robust when only physical child abuse was considered, demonstrating a lower pain pressure threshold (t (104) =-2.55, p=0.012, Fig. 1A) and more tender points (t (88) =3.29, p=0.001, Fig. 1B) compared to women without a physical child abuse history. A medium effect size of .31 was found for those with a history of physical child abuse and a smaller effect size of .193 for those with a history of emotional child abuse as compared to those without a child abuse history.

Using linear regression, a history of childhood abuse was associated with objective measures of pain sensitivity (Table II). Although not statistically significant, a history of any childhood abuse demonstrated trends toward lower pain pressure threshold (β=-0.19, p=0.057) and more tender points (β=0.16, p=0.096). However, physical childhood abuse was significantly associated with both lower pain threshold (β=-0.24, p=0.012) and a greater number of tender points (β=0.22, p=0.023) (Table II). These findings persisted even after adjustment for BMI, pain catastrophisation, a history of adult abuse, and depression.

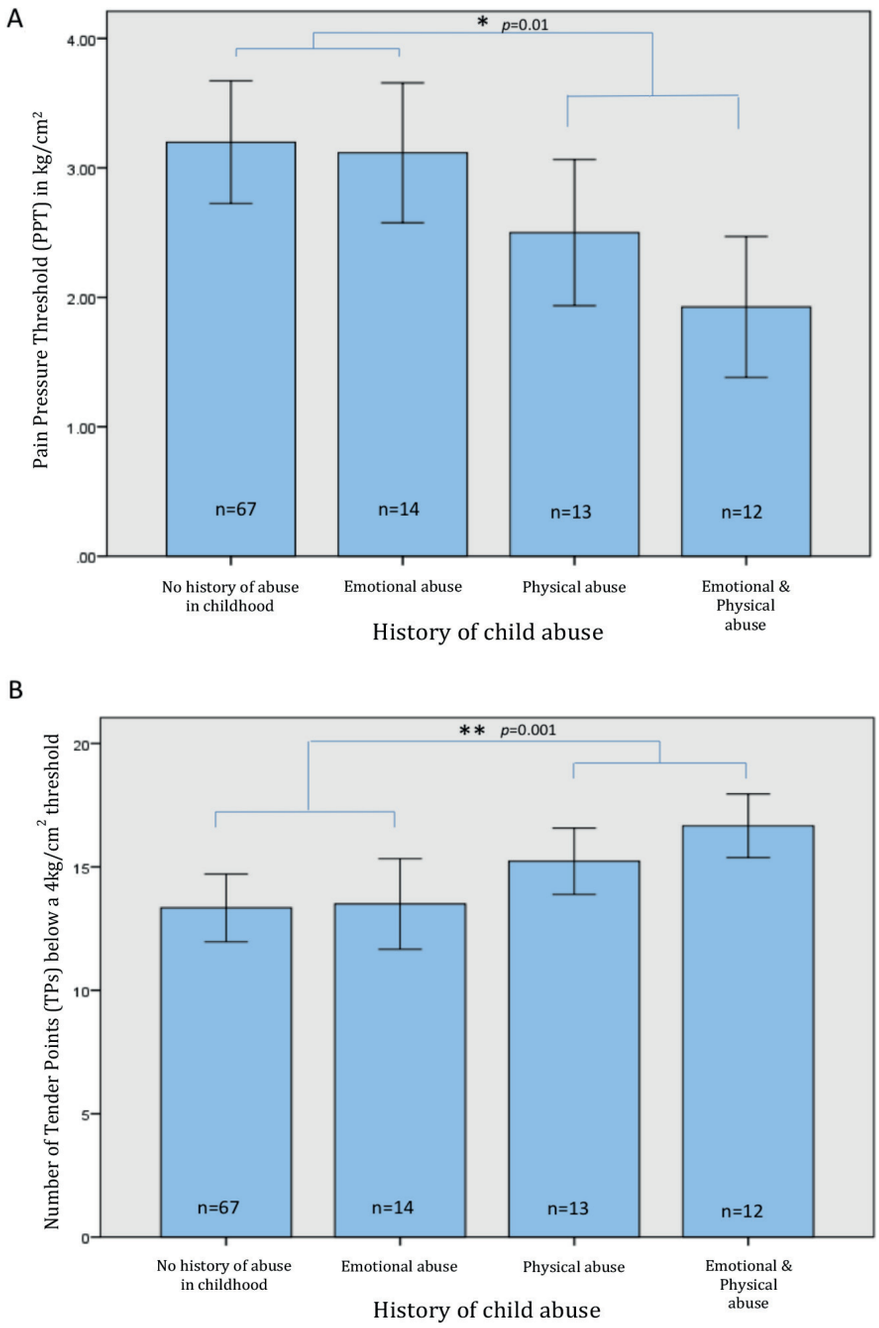

Fig. 1. Decreased pain pressure threshold in women with fibromyalgia and a history of child abuse. Women with a history of, specifically, physical child abuse had **A**) lower pain pressure threshold (p=0.012) and **B**) more tender points under a 4 kg/cm^2 pressure threshold (p=0.001) then women without a history of child abuse.

Fatigue and child abuse

The mean fatigue scores of women who completed the MFI questionnaire (n=110) are listed in Table I. Self-reported childhood abuse correlated significantly with increased general, physical, and mental fatigue but not in motivation or activity scores (Table III). No differences were seen in MFI scores between those with and without a history of adult abuse (p >0.20). Using linear regression, general, physical, and mental fatigue scores were associated with child abuse, but MFI motivation and activity scores were not (Table III). These relationships persisted after adjusting for adult abuse history, but

Table II. Abuse profile and pain sensitivity.

	Unadjusted		Adjusted for BMI		Adjusted for PCS		Adjusted for BMI and PCS	
	β	*p*	β	*p*	β	*p*	β	*p*
All child abuse								
Average PPT (kg/cm^2)	-0.19	0.057	-0.20	0.040*	-0.14	0.15	-0.17	0.097
Number of TPs<4 kg/cm^2 PPT	0.16	0.096	0.18	0.081	0.12	0.23	0.14	0.17
Physical child abuse								
Average PPT (kg/cm^2)	-0.24	0.012*	-0.28	0.005**	-0.22	0.019*	-0.25	0.011*
Number of TPs<4 kg/cm^2 PPT	0.22	0.023*	0.26	0.010*	0.20	0.041*	0.23	0.022*
Emotional child abuse								
Average PPT (kg/cm^2)	-0.13	0.18	-0.19	0.12	-0.07	0.48	-0.08	0.42
Number of TPs<4 kg/cm^2 PPT	0.11	0.26	0.10	0.31	0.06	0.56	0.07	0.53

PPT: Pain Pressure Threshold; PCS: Pain Catastrophisation Scale; BMI: Body Mass Index; TP: Tender Point.

not depressive symptoms (by HADS depression score) (p >0.05). When assessing for child abuse type (emotional or physical), MFI general and physical fatigue remained significantly associated with emotional abuse (β=0.20, p=0.042 and β=0.20, p=0.038, respectively) (Table III). When compared to those without a history of child abuse, the effect size was 0.24 for general fatigue and 0.25 for physical fatigue. Motivation fatigue score had a significant correlation with emotional child abuse (β=0.21, p=0.030) with a small to medium effect size (.24). None of the fatigue types were associated with physical child abuse. Of note, adjusting for BMI did not affect the significance of the findings.

Cognitive impairment, sleep, depression and child abuse

No association was found between a history of child abuse and waking unrefreshed as assessed by WPI as part of the 2010 criteria for FM (p >0.20). Similarly, no differences were seen in the cognitive domains of visual-perceptual ability, verbal memory, visual-spatial memory, or attention-concentration as assessed by the MASQ (p>0.10). However, women with a history of childhood abuse reported greater impairment in the language domain of the MASQ (t (104) =2.67, p=0.009). A history of physical abuse was associated with worse cognitive function in the domain of language even after adjusting for age and education (β=0.33, p=0.001) with a medium effect size of .344 when compared to those without a history of physical abuse in childhood. This relationship persisted when adjusting for depression (β=0.30, p=0.001). A greater severity of depressive symptoms was associated with a history of any child abuse (β=0.21, p=0.032), regardless of adjustment for a history of abuse in adulthood (β=0.21, p=0.033). The association between depression and the characteristics and symptom profiles of our study population can be seen in Table IV.

Table III. Abuse profile and fatigue.

	Unadjusted	
	β	*p*
All child abuse		
MFI general	0.22	0.020*
MFI physical	0.21	0.033*
MFI mental	0.19	0.045*
MFI motivation	0.14	0.16
MFI activity	0.10	0.29
Physical child abuse		
MFI general	0.20	0.042*
MFI physical	0.20	0.038*
MFI mental	0.10	0.30
MFI motivation	0.21	0.030*
MFI activity	0.08	0.42
Emotional child abuse		
MFI general	0.13	0.18
MFI physical	0.10	0.31
MFI mental	0.18	0.061
MFI motivation	0.03	0.77
MFI activity	0.11	0.25

MFI: Multidimensional Fatigue Inventory.

Discussion

We observed a modest, yet statistically significant, association between a history of child abuse and measures of pain sensitivity and tenderness in 111 women with FM. Decreased pain tolerance, both in overall threshold for pain and in the number of tender points with a threshold below 4 kg/cm^2 of pressure, was associated with a history of physical abuse, even after adjusting for BMI, pain catastrophising, and depression. We also demonstrated that physical childhood abuse is associated with the language domain of cognitive impairment. Interestingly, symptoms of fatigue and depression were associated with emotional child abuse more so than physical abuse. In this study, there was no association observed between a history of childhood abuse and sleep, as well as cognitive impairment, other than language. Taken together, our findings suggest that different types of child abuse have modest, but predictable, influences on particular FM symptoms later in life.

Our findings support the hypothesis that physical and psychosocial experiences of childhood are more influential than similar experiences in adulthood, perhaps related to the development and maturation of an interoceptive self-image (43, 44). Childhood abuse is a form of psychocultural and psychosocial environmental perturbation in that it yields a toxic and stressful environment for growth and emotional development, which has been tied to poor adult health (43, 45), such as adult functional pain disorders including fibromyalgia (13, 46). Given that not all patients with FM have a history of child abuse, the types of abuse appear to shape the contours of symptoms rather than being the etiologic cause of them (12).

We also observed that symptoms of fatigue are associated with emotional childhood abuse; however, the significant overlap between fatigue and depression may limit our ability to specifically interpret these findings. This observation is consistent with prior observations that emotional abuse in childhood has been associated with adult depression as compared to physical abuse (47). Although fatigue and depression are strongly associated, there is empirical evidence that they are also distinct entities. In a secondary analysis of data from the Sequenced Treatment

Table IV. The association between depression and the characteristics and symptom profile of women with fibromyalgia.

	PPT	PCS	MFI	MASQ	Waking unrefreshed	BMI
HADS-D (r, p)	-0.22, 0.026*	0.57, <0.001**	0.71, <0.001**	0.58, <0.001**	0.19, 0.059	0.27, 0.008**

HADS: Hospital Anxiety and Depression Scale; PPT: Pain Pressure Threshold; PCS: Pain Catastrophisation Scale; MFI: Multidimensional Fatigue Inventory; MASQ: Multiple Ability Self-Report Questionnaire; BMI: Body Mass Index. *p-value<0.05. **p-values <0.01.

Alternatives to Relieve Depression (STAR*D) study, approximately 40% of patients with partial or full remission of Major Depressive Disorder (MDD) after antidepressant therapy still reported persistent physical fatigue (48). This suggests that fatigue and depression are not always linked, however, they may not be easily distinguished based on the current tools of fatigue assessment, including the MFI (49, 50). Further, the psychobiological pathways of these conditions may be intimately interrelated (51). It has previously been shown that prior life trauma such as loss, as measured by the Trauma and Loss Spectrum Self-Report TALS-SR, and the associated traumatic experiences such as grief and re-experiencing of loss, may impact fatigue symptom severity in FM (52). Because we did not assess such prior traumatic experiences, and it is known that those with FM have significant mental health comorbities, it is possible that other types of trauma, aside from abuse, contribute to fatigue and pain symptom severity in FM. As measurement tools of fatigue develop, future studies will need to better address the relationships among emotional childhood abuse, fatigue, and depression, especially in the FM population where these components are prevalent.

After observing a modest association between child abuse and pain, as well as fatigue and depression, we decided to assess if the other symptoms of FM including sleep and cognitive impairment, might be associated with child abuse history. Although there were no differences in feeling unrefreshed upon waking by group, one cognitive domain on the MASQ demonstrated an association. Interestingly, we found that those with a history of child abuse reported greater dysfunction in the cognitive domain of language, as assessed by the MASQ. It has been demonstrated that child victims of sexual abuse demonstrate thought disorder and, specifically, difficulty with word usage (53). Although we found modest evidence that a similar association may persist into adulthood within the FM population, it is unclear why there was an association with this domain specifically and not other domains. It is also possible that the significant finding is the result of multiple comparisons.

Controversy exists in the literature regarding the classification of the symptoms complex, which is currently known as fibromyalgia, as one of psychocultural and psychosocial factors or of dysfunctional central pain processing (6, 7). Evidence of psychosocial associations in FM is not incompatible with observations that FM has neurobiological correlates (54). Multiple lines of evidence show that early life stress and trauma have lasting physiological implications (12, 16, 17, 55). It is likely that the correlations we found between child abuse and lowered pain threshold have a neurobiological underpinning. However, we did not assess neurobiological variables, and therefore cannot speak to these acting as potential mediators. Future, prospective investigations of abuse will be needed to elucidate the potential neurobiological underpinnings of our findings.

There are several strengths to this study. We assessed the association of childhood abuse history across the symptom profile in patients with FM, not simply with a diagnosis of fibromyalgia (56). Our findings relate to quantitative, rather than qualitative measurements, of pain. We also assessed the contributions of pain catastrophisation and depression to our findings. In addition, we considered abuse in childhood separate from that in adulthood, by adjusting for history of abuse in adulthood, which improves on the design of studies that have only assessed either abuse in general or solely in childhood (9, 11, 57, 58). Finally, we compared rather than collapsed abuse types, which allowed us to identify different symptom relationships depending on emotional and physical abuse profiles.

There are also limitations to the present study. It was a cross-sectional study of modest sample size, limiting any causal attribution to inference. This was a retrospective analysis and abuse history was measured by patient recall, which is prone to bias (59). However, abuse history was obtained by face-to-face clinician interviews, which has been shown to be similarly reliable as self-report when obtaining childhood sexual abuse data (60). Still, it is a limitation to have one author categorise a reported trauma as abuse, physical or emotional, without separate quantification of sexual abuse history, and emphasises the constraints of not having used a validated tool such as the childhood trauma questionnaire (CTQ) (61) as should be done in future studies. PTSD (62), cumulative trauma, and psychological distress, including major loss (52), are commonly comorbid in persons with FM and these variables were also not directly assessed. Further, the fact that trauma, including abuse, is self-reported in a population that has significant mental health comorbidities could contribute to over or underestimations (63, 64). Future studies should consider how a history of childhood abuse, sexual abuse, and other lifetime traumas, affects the trajectory of symptoms, and intervention outcomes, in FM using a longitudinal design. Despite these limitations, our study quantitatively demonstrates that physical child abuse has modest, but statistically significant effects on pain thresholds.

Conclusion

In conclusion, we provide evidence that particular child abuse experiences are associated with specific FM symptoms. This study provides inferential evidence that particular childhood events have a predictable impact on future

somatic experiences. Although differences between groups were small and do not directly impact clinical practice, it seems plausible that the experience of abuse shapes the biologic underpinnings of fatigue and pain sensitivity.

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References

1. CAMPOS RP, VAZQUEZ RODRIGUEZ MI: Health-related quality of life in women with fibromyalgia: clinical and psychological factors associated. *Clin Rheumatol* 2012; 31: 347-55.
2. CASTRO-SANCHEZ AM, MATARÁN-PEÑAROCHA GA, LÓPEZ-RODRÍGUEZ MM, LARA-PALOMO IC, ARENDT-NIELSEN L, FERNÁNDEZ-DE-LAS-PEÑAS C: Gender differences in pain severity, disability, depression, and widespread pressure pain sensitivity in patients with fibromyalgia syndrome without comorbid conditions. *Pain Med* 2012; 13: 1639-47.
3. WHITE KP, SPEECHLEY M, HARTH M, OSTBYE T: Co-existence of chronic fatigue syndrome with fibromyalgia syndrome in the general population. A controlled study. *Scand J Rheumatol* 2000; 29: 44-51.
4. WOLFE F, CLAUW DJ, FITZCHARLES MA *et al*.: The American College of Rheumatology preliminary diagnostic criteria for fibromyalgia and measurement of symptom severity. *Arthritis Care Res* 2010; 62: 600-10.
5. RAMIRO FD, LOMBARDI JÚNIOR I, DA SILVA RC *et al*.: Investigation of stress, anxiety and depression in women with fibromyalgia: a comparative study. *Rev Bras Reumatol* 2014; 54: 27-32.
6. ENGLISH B: Neural and psychosocial mechanisms of pain sensitivity in fibromyalgia. *Pain Manag Nurs* 2014; 15: 530-8.
7. WOLFE F, WALITT B: Culture, science and the changing nature of fibromyalgia. *Nature reviews. Rheumatology* 2013; 9: 751-5.
8. HÄUSER W, SCHMUTZER G, BRAHLER E, GLAESMER, H: A cluster within the continuum of biopsychosocial distress can be labeled "fibromyalgia syndrome"--evidence from a representative German population survey. *J Rheumatol* 2009; 36: 2806-12.
9. CASTRO I, BARRANTES F, TUNA M *et al*.: Prevalence of abuse in fibromyalgia and other rheumatic disorders at a specialized clinic in rheumatic diseases in Guatemala City. *J Clin Rheumatol* 2005; 11: 140-5.
10. AFARI N, AHUMADA SM, WRIGHT LJ *et al*.: Psychological trauma and functional somatic syndromes: a systematic review and meta-analysis. *Psychosom Med* 2014; 76: 2-11.
11. ALEXANDER RW, BRADLEY LA, ALARCÓN GS *et al*.: Sexual and physical abuse in women with fibromyalgia: association with outpatient health care utilization and pain medication usage. *Arthritis Care Res* 1998; 11: 102-15.
12. LOEVINGER BL, SHIRTCLIFF EA, MULLER D, ALONSO C, COE CL: Delineating psychological and biomedical profiles in a heterogeneous fibromyalgia population using cluster analysis. *Clin Rheumatol* 2012; 31: 677-85.
13. HÄUSER W, HOFFMANN EM, WOLFE F *et al*.: Self-reported childhood maltreatment, lifelong traumatic events and mental disorders in fibromyalgia syndrome: a comparison of US and German outpatients. *Clin Exp Rheumatol* 2015; 33 (Suppl. 88): S86-92.
14. CLOITRE M, STOLBACH BC, HERMAN JL *et al*.: A developmental approach to complex PTSD: childhood and adult cumulative trauma as predictors of symptom complexity. *J Trauma Stress* 2009; 22: 399-408.
15. MILLER GE, COLE SW: Clustering of depression and inflammation in adolescents previously exposed to childhood adversity. *Biol Psychiatry* 2012; 72: 34-40.
16. DANESE A, MOFFITT TE, HARRINGTON H *et al*.: Adverse childhood experiences and adult risk factors for age-related disease: depression, inflammation, and clustering of metabolic risk markers. *Arch Pediatr Adolesc Med* 2009; 163: 1135-43.
17. DANESE A, MCEWEN BS: Adverse childhood experiences, allostasis, allostatic load, and age-related disease. *Physiol Behav* 2012; 106: 29-39.
18. SANSONE RA, WATTS DA, WIEDERMAN MW: Childhood trauma and pain and pain catastrophizing in adulthood: a cross-sectional survey study. *Prim Care Companion CNS Disord* 2013; 15: doi:10.4088/PCC.13m01506.
19. LOW LA, SCHWEINHARDT P: Early life adversity as a risk factor for fibromyalgia in later life. *Pain Res Treat* 2012; 2012: 140832.
20. TAYLOR RR, JASON LA: Chronic fatigue, abuse-related traumatization, and psychiatric disorders in a community-based sample. *Soc Sci Med* 2002; 55: 247-56.
21. PLUCK G, LEE KH, DAVID R, MACLEOD DC, SPENCE SA, PARKS RW: Neurobehavioural and cognitive function is linked to childhood trauma in homeless adults. *Br J Clin Psychol* 2011; 50: 33-45.
22. MAJER M, NATER UM, LIN JM, CAPURON L, REEVES WC: Association of childhood trauma with cognitive function in healthy adults: a pilot study. *BMC Neurol* 2010; 10: 61.
23. GOLDBERG X, ALEMANY S, FATJÓ-VILAS M *et al*.: Twin-based study of the complex interplay between childhood maltreatment, socioeconomic status and adult memory. *Eur Arch Psychiatry Clin Neurosci* 2013; 263: 435-40.
24. CHAPMAN DP, LIU Y, PRESLEY-CANTRELL LR *et al*.: Adverse childhood experiences and frequent insufficient sleep in 5 U.S. States, 2009: a retrospective cohort study. *BMC Public Health* 2013; 13: 3.
25. CHAPMAN DP, WHEATON AG, ANDA RF *et al*.: Adverse childhood experiences and sleep disturbances in adults. *Sleep Med* 2011; 12: 773-9.
26. CARR CP, MARTINS CM, STINGEL AM, LEMGRUBER VB, JURUENA MF: The role of early life stress in adult psychiatric disorders: a systematic review according to childhood trauma subtypes. *J Nerv Ment Dis* 2013; 201: 1007-20.
27. WOLFE F, SMYTHE HA, YUNUS MB *et al*.: The American College of Rheumatology 1990 Criteria for the Classification of Fibromyalgia. Report of the Multicenter Criteria Committee. *Arthritis Rheum* 1990; 33: 160-72.
28. WALTON DM, LEVESQUE L, PAYNE M, SCHICK J: Clinical pressure pain threshold testing in neck pain: comparing protocols, responsiveness, and association with psychological variables. *Phys Ther* 2014; 94: 827-37.
29. ARNOLD LM, PRITCHETT YL, D'SOUZA DN, KAJDASZ DK, IYENGAR S, WERNICKE JF: Duloxetine for the treatment of fibromyalgia in women: pooled results from two randomized, placebo-controlled clinical trials. *J Womens Health* 2007; 16: 1145-56.
30. SMETS EM, GARSSEN B, BONKE B, DE HAES JC: The Multidimensional Fatigue Inventory (MFI) psychometric qualities of an instrument to assess fatigue. *J Psychosom Res* 1995; 39: 315-25.
31. HÄUSER W, URRUTIA G, TORT S, UCEYLER N, WALITT B: Serotonin and noradrenaline reuptake inhibitors (SNRIs) for fibromyalgia syndrome. *Cochrane Database Syst Rev* 2013; 1: CD010292.
32. WILLIAMS DA, ARNOLD LM: Measures of fibromyalgia: Fibromyalgia Impact Questionnaire (FIQ), Brief Pain Inventory (BPI), Multidimensional Fatigue Inventory (MFI-20), Medical Outcomes Study (MOS) Sleep Scale, and Multiple Ability Self-Report Questionnaire (MASQ). *Arthritis Care Res* 2011; 63 (Suppl. 11): S86-97.
33. SEIDENBERG M, HALTINER A, TAYLOR MA, HERMANN BB, WYLER A: Development and validation of a Multiple Ability Self-Report Questionnaire. *J Clin Exp Neuropsychology* 1994; 16: 93-104.
34. WILLIAMS DA, CLAUW DJ, GLASS JM: Perceived cognitive dysfunction in fibromyalgia syndrome. *J Musculoskelet Pain* 2011; 19: 66-75.
35. CLEELAND CS, RYAN KM: Pain assessment: global use of the Brief Pain Inventory. *Ann Acad Med Singapore* 1994; 23: 129-38.
36. KELLER S, BANN CM, DODD SL, SCHEIN J, MENDOZA TR, CLEELAND CS: Validity of the brief pain inventory for use in documenting the outcomes of patients with noncancer pain. *Clin J Pain* 2004; 20: 309-18.
37. BJELLAND I, DAHL AA, HAUG TT, NECKELMANN D: The validity of the Hospital Anxiety and Depression Scale. An updated literature review. *J Psychosom Res* 2002; 52: 69-77.
38. OSMAN A, BARRIOS FX, KOPPER BA, HAUPTMANN W, JONES J, O'NEILL E: Factor structure, reliability, and validity of the Pain Catastrophizing Scale. *J Behav Med* 1997; 20: 589-605.
39. ROTHMAN KJ: No adjustments are needed for multiple comparisons. *Epidemiology* 1990; 1: 43-6.
40. COHEN J: A power primer. *Psychol Bull* 1992; 112: 155-9.
41. HÄUSER W, BOHN D, KÜHN-BECKER H, ERDKÖNIG R, BRÄHLER E, GLAESMER H.: Is the association of self-reported childhood maltreatments and adult fibromyalgia syndrome attributable to depression? A case

control study. *Clin Exp Rheumatol* 2012; 30 (Suppl. 74): S59-64.
42. NEUMANN L, LERNER E, GLAZER Y, BOLOTIN A, SHEFER A, BUSKILA D: A cross-sectional study of the relationship between body mass index and clinical characteristics, tenderness measures, quality of life, and physical functioning in fibromyalgia patients. *Clin Rheumatol* 2008; 27: 1543-7.
43. SHONKOFF JP, GARNER AS; COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH; COMMITTEE ON EARLY CHILDHOOD, ADOPTION, AND DEPENDENT CARE; SECTION ON DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS: The lifelong effects of early childhood adversity and toxic stress. *Pediatrics* 2012; 129: e232-246.
44. FELDENKRAIS M: in *Feldenkrais Resources: Collected Articles by and Interviews with Moshe Feldenkrais* 352-363 (Feldenkrais Resources, 1992).
45. FELITTI VJ, ANDA RF, NORDENBERG D *et al*.: Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med* 1998; 14: 245-58.
46. KATON W, SULLIVAN M, WALKER E: Medical symptoms without identified pathology: relationship to psychiatric disorders, childhood and adult trauma, and personality traits. *Ann Int Med* 2001; 134: 917-25.
47. MARTINS CM, VON WERNE BAES C, DE CARVALHO TOFOLI SM, JURUENA MF: Emotional abuse in childhood is a differential factor for the development of depression in adults. *J Nerv Ment Dis* 2014.
48. FERGUSON M, DENNEHY EB, MARANGELL LB, MARTINEZ J, WISNIEWSKI SR: Impact of fatigue on outcome of selective serotonin reuptake inhibitor treatment: secondary analysis of STAR*D. *Curr Med Res Opin* 2014; 30: 2109-18.
49. SOYUER F, SENOL V: Functional outcome and depression in the elderly with or without fatigue. *Arch Gerontol Geriatr* 2011; 53: e164-167.
50. LAVIDOR M, WELLER A, BABKOFF H: Multidimensional fatigue, somatic symptoms and depression. *Br J Health Psychol* 2002; 7: 67-75.
51. BAKSHI R, SHAIKH ZA, MILETICH RS *et al*.: Fatigue in multiple sclerosis and its relationship to depression and neurologic disability. *Mult Scler* 2000; 6: 181-5.
52. DELL'OSSO L, CARMASSI C, CONSOLI G *et al*.: Lifetime post-traumatic stress symptoms are related to the health-related quality of life and severity of pain/fatigue in patients with fibromyalgia. *Clin Exp Rheumatol* 2011; 29 (Suppl. 69): S73-78.
53. CONWAY F, MCCARTHY J, TALREJA P, CONWAY F: Thought and language disorder among sexually abused children in a psychiatric hospital. *Psychol Rep* 2013; 112: 340-52.
54. MALETIC V, RAISON CL: Neurobiology of depression, fibromyalgia and neuropathic pain. *Front Biosci* (Landmark Ed) 2009; 14: 5291-338.
55. WEISSBECKER I, FLOYD A, DEDERT E, SALMON P, SEPHTON S: Childhood trauma and diurnal cortisol disruption in fibromyalgia syndrome. *Psychoneuroendocrinology* 2006; 31: 312-24.
56. IMBIEROWICZ K, EGLE UT: Childhood adversities in patients with fibromyalgia and somatoform pain disorder. *Eur J Pain* 2003; 7: 113-9.
57. BOHN D, BERNARDY K, WOLFE F, HÄUSER W: The association among childhood maltreatment, somatic symptom intensity, depression, and somatoform dissociative symptoms in patients with fibromyalgia syndrome: a single-center cohort study. *J Traum Dissociation* 2013; 14: 342-58.
58. CICCONE DS, ELLIOTT DK, CHANDLER HK, NAYAK S, RAPHAEL KG: Sexual and physical abuse in women with fibromyalgia syndrome: a test of the trauma hypothesis. *The Clin J Pain* 2005; 21: 378-86.
59. WINGENFELD K, TERFEHR K, MEYER B, LOWE B, SPITZER C: Memory bias for emotional and illness-related words in patients with depression, anxiety and somatization disorders: an investigation with the directed forgetting task. *Psychopathology* 2013; 46: 22-7.
60. MARTIN J, ANDERSON J, ROMANS S, MULLEN P, O'SHEA M: Asking about child sexual abuse: methodological implications of a two stage survey. *Child Abuse Negl* 1993; 17: 383-92.
61. BERNSTEIN DP, AHLUVALIA T, POGGE D, HANDELSMAN L: Validity of the Childhood Trauma Questionnaire in an adolescent psychiatric population. *J Am Acad Child Adolesc Psychiatry* 1997; 36: 340-8.
62. HÄUSER W, GALEK A, ERBSLÖH-MÖLLER B *et al*.: Posttraumatic stress disorder in fibromyalgia syndrome: prevalence, temporal relationship between posttraumatic stress and fibromyalgia symptoms, and impact on clinical outcome. *Pain* 2013; 154: 1216-23.
63. MCKINNEY CM, HARRIS TR, CAETANO R: Reliability of self-reported childhood physical abuse by adults and factors predictive of inconsistent reporting. *Violence Vict* 2009; 24: 653-68.
64. JONZON E, LINDBLAD F: Adult female victims of child sexual abuse: multitype maltreatment and disclosure characteristics related to subjective health. *J Interpers Violence* 2005; 20: 651-66.