Published in final edited form as:

Vulnerable Child Youth Stud. 2017 ; 12(4): 304–313. doi:10.1080/17450128.2017.1371817.

Relationship between infant malnutrition and childhood maltreatment in a Barbados lifespan cohort

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Abstract

Childhood malnutrition and maltreatment (abuse, neglect) are both prevalent, particularly in resource-limited settings. Despite their known negative impact on child development, there is surprisingly little research documenting their interrelationships. To address this gap, we administered the Childhood Trauma Questionnaire-Short Form (CTQ-SF), a retrospective structured self-report of childhood abuse and neglect, in a Barbadian cohort of 77 adult survivors

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Statement of Ethical Standards

This study has been approved by the appropriate ethics committee. All study participants provided written informed consent and were compensated for their time and travel expenses (IRB Protocol 2015P000329/MGH).

Disclosure statement

The authors declare that they have no conflict of interest.

of infant malnutrition, limited to the first year of life, and 62 healthy controls from the same classrooms and neighborhoods (mean age $\pm$ SD = 43.8 $\pm$ 2.3 years). This cohort has been followed since birth. Using factor analysis and comparison with archival data addressing similar constructs, we found evidence for reliability and validity of the CTQ-SF in this population. Linear regression analyses, with and without adjusting for childhood household standard of living at three childhood ages, revealed that a history of infant malnutrition was significantly associated with increased levels of self-reported physical neglect in childhood, and, to a somewhat lesser degree, emotional neglect. This study highlights the co-occurrence of infant malnutrition and self-reported maltreatment in childhood in Barbados, with potential public health implications.

Keywords

birth cohort; child public health; disadvantage; epidemiology; family influences; mental health

Introduction

Childhood malnutrition and maltreatment (abuse, neglect) are prevalent worldwide, particularly in resource-limited settings, and both can affect health, educational, and economic outcomes throughout the life course (Akmatov, 2011; UNICEF Barbados 2015). Each of these early exposures can have lasting effects on physical and mental health, including altered stress response (Puetz et al., 2016; Rosen et al., 2004); increased inflammatory factors (Bourke, Berkley, & Prendergast, 2016; Coelho et al., 2014), and increased risk for cognitive and mental health problems (Galler et al., 2012; 2013; Young & Widom, 2014). In addition, they likely share some of the same risk factors, such as strained family economic resources (Brown et al., 1998; Walker et al., 2007).

Child maltreatment and poor nutrition are most often studied independently particularly in resource-limited settings (Black & Drennen, 2014). However, findings from the Adverse Childhood Experiences Study (ACE) demonstrate a relationship between the total number of early adversities experienced and risk of later mental health problems (Anda et al., 2006). Because exposure to multiple adversities is more common than isolated exposures (Jacobs et al., 2012), it is important to investigate patterns of co-occurrence, especially in diverse populations globally. Empirical documentation of the extent of co-occurrence of malnutrition and maltreatment could advance our understanding of developmental processes in children exposed to multiple adversities and could also inform future studies on the independent and synergistic effects of these childhood adversities.

In the US, failure to thrive (FTT), a condition characterized by a failure to gain weight in relationship to growth, has been linked to childhood neglect (Block et al., 2005). This finding, however, is controversial, and other studies have not supported significant associations between neglect and underweight in these populations (Black et al., 2006). In addition, children with FTT may or may not have a clinical diagnosis of moderate-severe malnutrition. There are very few studies that have examined the co-occurrence of childhood malnutrition and maltreatment in developing countries. We did however find reports of

associations between childhood malnutrition and inter-partner family violence in these settings (Hasselmann & Reichenheim, 2006; Ziaei, Naved, & Ekstrom, 2014).

Research on child abuse and neglect can encounter significant methodological challenges. For instance, some studies rely on reports to Child Protective Services to identify individuals who had been potentially exposed to abuse or neglect. This strategy, however, risks under-identification, since most instances of child maltreatment go unreported (Gilbert et al., 2009). Moreover, cases identified through official reports are more likely to involve the more visible instances of maltreatment, such as physical or sexual abuse. Underreporting of emotional abuse and emotional or physical neglect may be even more frequent due to their lower visibility (Widom, Czaja, & Dumont, 2015). Prospective studies also raise ethical issues that can have unavoidable impact on the findings, because disclosure of child maltreatment mandates intervention. Retrospective approaches, however, are more likely to include individuals who experienced maltreatment over longer periods of time without intervention (Kendall-Tackett & Becker-Blease, 2004) but the retrospective reporting raises concerns about accuracy of the report.

The primary aim of the present study is to assess the relationship between a medically-documented history of infant malnutrition and self-reported history of childhood abuse and neglect among participants of the Barbados Nutrition Study (BNS). The BNS is a multigenerational study, now extending over 45 years, based on a cohort that had experienced moderate to severe malnutrition in the first year of life and a healthy comparison group. At the time the study began in the 1970s, malnutrition was a significant concern in the country but has since been eliminated due to the improved economy as well as the implementation of an island-wide nutrition education program (Ramsey, Demas, & Trotter, 1984). Study participants, currently adults in mid-life, provided retrospective reports of sexual, physical and emotional abuse and also physical and emotional neglect during childhood using the Childhood Trauma Questionnaire – Short Form (CTQ-SF) (Bernstein et al., 2003), a reliable and well-validated instrument for obtaining retrospective data from adults on their childhood experiences. We predicted that self-reported abuse and neglect would be increased in the previously malnourished group relative to controls. We also examined the psychometric properties and validity of the CTQ-SF in this population to assure that the questionnaire was appropriate for the Barbadian setting. The CTQ has not been previously validated for use in the Caribbean and, to our knowledge, has been used only once in the region, in Haiti (Martsolf, 2004).

Materials and Methods

Site

Barbados is a Caribbean country with 284,000 inhabitants: 92% are of African/Caribbean origin, 4% Caucasian, and the remaining groups are mostly of Asian, Lebanese, or Syrian descent. The literacy rate is 99% and schooling is obligatory until 16 years of age. In 1970, infant mortality was 46 per 1,000 live births but is now 11 (IndexMundi). Barbados ranks 57/188 countries on the Human Development Index (UNDP, 2015). Although official data on child abuse and neglect in Barbados were not available for the period studied in this report, 4,868 children (7% of those under 18 years) were affected by child abuse between

2008 and 2013 (UNICEF Barbados, 2015). These official statistics likely underestimate the true magnitude of the problem, given that Barbados currently has no mandatory reporting of child maltreatment.

Participants

The Barbados Nutrition Study is a prospective cohort study that has followed individuals who experienced moderate to severe protein energy malnutrition (PEM) in their first year of life, as well as healthy community controls, who were recruited in early childhood and drawn from the same classrooms. Details of the study have been described elsewhere (Galler et al., 1983; 1987).

Of the 312 individuals in the original cohort, 64 individuals were ineligible to participate in the adult wave of data collection (53 are overseas, 10 deceased, 1 imprisoned) leaving 248 eligible participants. Due to funding limitations, we were able to evaluate 175 out of 248 (71%) and 139/248 individuals completed the CTQ-SF (56% of the eligible participants). The subset of the original cohort in the present study included 77 malnourished and 62 controls, born between 1967 and 1972. We compared this subset with the non-participants and found no differences in age, gender, childhood socioeconomic status, or IQ (Galler et al., 2012). All study participants provided written informed consent and were compensated for their time and travel expenses (IRB Protocol 2015P000329/MGH).

Measures

Childhood maltreatment—The CTQ-SF (Bernstein et al., 2003) is a 25-item retrospective self-report instrument that assesses the frequency and severity of abuse and neglect in childhood. It contains five sub-categories with five questions each: physical abuse (PA), sexual abuse (SA), emotional abuse (EA), physical neglect (PN), and emotional neglect (EN). Items are rated on a 5-point Likert scale (ranging from “never true” = 1 to “very often true” = 5), yielding scores ranging from 5 to 25 for each trauma sub-category and from 25 to 125 for the total CTQ score. Items worded positively are reverse-coded so that higher scores on all items reflect more maltreatment. For regression analyses, total CTQ-SF scores were divided by 10 and subscale scores by 5 (approximate standard deviations for each) to ease interpretability of results. The CTQ-SF has been shown to have measurement invariance across diverse populations, including US residents with varying maltreatment histories (Bernstein et al., 2003). It has been validated in high-, middle-, and low-income countries, including Spain (Hernandez et al., 2013), Switzerland (Charak & Root, 2014; Karos et al., 2014), Rwanda (Rieder & Elbert, 2013), Togo (Kounou et al., 2013), and Brazil (Grassi-Oliveira et al., 2014).

Household Standard of Living During Childhood and Adolescence—Household standard of living was assessed at three time points during childhood and adolescence (in 1977 at 5–11 yrs, 1982 at 9–15 yrs and 1984 at 11–17 yrs) using the 50-item Barbados Ecology Questionnaire (Galler et al., 1985; 2012). This questionnaire included items related to living conditions in the home, and the income, educational and occupational backgrounds of the parents. Factor analyses had previously been performed on questionnaire data from the full cohort at three childhood ages, and one primary factor emerged from this analysis

that captured household standard of living (household possessions, including refrigerator, TV, electricity, etc., number of bedrooms/rooms, food expenditure, and household income) (Galler et al., 2010).

Statistical Methods

Data analyses were conducted using SAS software, Version 9.4 (SAS Institute, 2013). Because individuals with histories of marasmus and kwashiorkor did not differ significantly on any outcome (data not shown), their data were combined for all analyses.

Participant characteristics

Demographic characteristics of the groups, including gender, age at CTQ-SF administration, birth weight, mother's age at the time of their birth and childhood SES (measured at three time points), were compared by Student's t-tests and chi-squared tests.

Psychometric properties of the CTQ-SF in the Barbados sample

To assure reliability and validity of the CTQ-SF in Barbados, we performed principal components analysis (PCA) with factor-extraction of the CTQ-SF items, followed by normal varimax rotation, to identify groups of related items. The final number of factors was determined by identifying groupings of meaningful items and minimal overlap or dropped items across factors. We calculated Cronbach's alphas (Cronbach, 1951) to assess the internal consistencies of the CTQ-SF subcategories and total score and the derived factors in our sample. Factor scores were standardized to have zero mean and unit variance to ease interpretability.

History of infant malnutrition and childhood maltreatment in Barbados

We assessed the relationship between history of infant malnutrition and childhood maltreatment utilizing linear regressions with malnutrition history as the independent variable and the five abuse and neglect categories, as well as CTQ-SF total scores, as dependent variables. Factor scores derived from the PCA of the CTQ-SF were also included as dependent variables. We adjusted for childhood standard of living at 3 childhood ages (using Proc Mixed in SAS). We also examined nutrition history by severity categories of reported physical, sexual, and emotional abuse and physical and emotional neglect using Fisher's Exact Test.

Results

Participant characteristics

The previously malnourished group had lower household standard of living at all three childhood time points as compared with control households (Table 1). Birth weight, maternal age at the participant's birth, gender distribution, and participant age did not differ significantly by nutrition group ($p < 0.05$). We therefore adjusted for household standard of living in the final multivariate analyses described below.

Psychometric properties of the CTQ-SF in the Barbados sample

The total CTQ-SF score and each of the five standard CTQ-SF subcategories all had good internal consistencies and reliabilities, as follows: total CTQ-SF ($\alpha = 0.90$), physical abuse ($\alpha = 0.80$), emotional abuse ($\alpha = 0.84$), sexual abuse ($\alpha = 0.95$), emotional neglect ($\alpha = 0.84$) and physical neglect ($\alpha = 0.58$).

PCA of the CTQ-SF yielded a three-factor rotated solution as the best fitting model (Table 2). This model accounted for 54% of the total variance, contained the least overlap between the items loading onto factors, and yielded meaningful factor categories. The three rotated, independent factors (with Eigenvalue of 8.12, 3.33, and 2.08, respectively) appeared to represent: *Factor 1*) Physical and emotional abuse; *Factor 2*) Sexual abuse; and *Factor 3*) Emotional and physical neglect. Overall, the items loaded onto similar but not identical categories as those in the original instrument. Thus, physical and emotional abuse items loaded onto a single factor (Factor 1) as did physical and emotional neglect items (Factor 3). The internal consistency of each of the three factors was good, as shown in the table. We therefore utilized both the original scales and the Barbados specific factors.

As an additional validity check, we consulted archival data to compare relevant items reported by the primary caretaker in earlier years of this study with the CTQ-SF factor scores reported by the participant in middle adulthood. We found modest but statistically significant relationships that provide some validation for the adult reports. For instance, Factor 3 (Emotional and Physical Neglect) was negatively correlated with the participant having books ($r = -0.14$, $p = 0.01$) and toys/games ($r = -0.12$; $p = 0.04$) in the household as a child.

History of infant malnutrition and childhood maltreatment in Barbados

Although the previously malnourished participants had higher mean scores than controls within each CTQ-SF maltreatment sub-category, the only difference that reached statistical significance for the unadjusted scores was physical neglect ($p = 0.004$) with a trend for emotional neglect ($p = 0.059$). The association between childhood malnutrition and physical neglect remained significant after adjustment. Additionally, individuals with malnutrition histories were overrepresented in the more severe categories for all forms of self-reported abuse and neglect (all $p < 0.05$). Results were most pronounced for physical neglect when comparing malnourished vs. control percentage values (no/minimal: 47% vs. 76%; low: 30% vs 15%; moderate: 12% vs 5%; severe: 12% vs 5%; $p < 0.0001$, Fisher's exact test).

The results of analyses using factor scores were similar to those using the standard CTQ-SF scales. Factor 3 (Emotional/physical neglect) was significantly associated with history of malnutrition in the unadjusted model, and remained associated at a trend level in the standard of living-adjusted model ($p = 0.057$). However, the two other factors, Physical/emotional and Sexual Abuse were not associated with history of childhood malnutrition.

Finally, because of the potential confounding of the CTQ-SF food-related question (Table 2, Q1) with the early history of malnutrition, we recreated the total CTQ-SF scores and also the Factor 3 scores eliminating this item from the analyses. Without this question included, the revised alpha reliabilities were as follows: Factor 3 = 0.84 and total CTQ-SF score = 0.91.

The results of the multiple regression analyses were the same with and without including the food item.

Discussion

The primary aim of this study was to assess the potential relationship between a history of infant malnutrition and self-reported childhood maltreatment (abuse and neglect) in a Barbados population. We found that individuals who had been malnourished as infants reported higher levels of physical neglect during childhood, a relationship that remained statistically significant even after accounting for childhood standard of living. Emotional neglect was also associated with history of malnutrition, but this association was attenuated by including childhood standard of living in the model. Individuals with histories of malnutrition also were overrepresented in the higher severity categories of self-reported maltreatment for all abuse and neglect subscales but these were not adjusted due to small sample sizes within each of the cells.

The meaning of the association between childhood malnutrition and physical neglect observed in this Barbadian sample should be interpreted cautiously. Although the malnutrition episode antedated the self-reported abuse/neglect, family contexts that lead to child malnutrition may also be more likely to lead to child neglect, and other forms of maltreatment, due to common risk factors such as low socioeconomic status and strained resources. Although we did observe a slight attenuation in the strength of the association between infant malnutrition and physical neglect when adjusting for childhood standard of living, the persistence of the association suggests that factors other than standard of living are involved.

Another plausible connection is that children exposed to early malnutrition experienced emotional and physical neglect secondary to their increased psychological and behavioral problems referable to their malnutrition history. These problems can involve conduct (Galler et al., 2012) and attention (Galler & Ramsey, 1989) problems, as well as depressive symptoms (Galler et al., 2010). The child's psychological and/or behavioral difficulties may then influence the parent-child relationship (Larsson et al., 2008). As with parent-child interactions more generally, these relationships could likely be bi-directional.

Our findings, thus, underscore the importance of studying multiple adversities together instead of assessing each independently. The patterns we found in malnutrition and maltreatment co-occurrence in this Barbados cohort can inform future research on the long-term outcomes of such exposures.

Strengths of the present study include a community-based sample, well-documented clinical measures of malnutrition during a defined period in infancy, psychometric validation of the CTQ-SF for Barbados, the availability of lifespan longitudinal data, and a childhood standard of living measure developed specifically for the Barbados setting and measured repeatedly during childhood and adolescence. Since data were collected from different sources over time (e.g., malnutrition was assessed by a clinician in infancy, childhood standard of living from maternal reports and home visits at three time points, and

maltreatment by self-report in adulthood), the possibility of shared reporting bias was minimized. Moreover, we found evidence of the reliability and validity of the CTQ-SF in our study population. There was good internal consistency of the scales and factors, and the factor content and structure were similar to what has previously been reported in Brazil and India (Charak & Root, 2014; Grassi-Oliveira et al., 2014). There was also significant correspondence between the CTQ-SF and reports by the participants' mothers 30–40 years earlier during childhood. Finally, reports of maltreatment history obtained from participants directly should provide a less biased estimate of the true prevalence and severity than if we had relied on reports referred to the attention of authorities (Gilbert et al., 2009). While Barbados does not have a policy of obligatory reporting of child maltreatment, an obligatory reporting policy is currently under consideration (Barbados Today, 2016), making this study timely.

This study also has limitations. The CTQ-SF does not provide information about the specific ages of the child when the maltreatment occurred. Also, as indicated, retrospective reporting could be inaccurate or biased by other influences. For ethical reasons, however, childhood maltreatment is often assessed retrospectively, so our approach is comparable to that of other studies (e.g., Kohrt, et al., 2015; Teicher & Parigger, 2015). Since studies comparing retrospective to prospective reports of maltreatment have found that, if anything, adults are more likely to minimize their degree of exposure on retrospective reporting (Shaffer, Huston, & Egeland, 2008), our use of a retrospective measure could have underestimated the association. Although we did adjust for standard of living during childhood and adolescence using a locally-developed and validated measure, we recognize that there may be other explanatory variables that were not accounted for. Finally, as with all longitudinal studies, there was attrition. There were not, however, significant differences between BNS participants and non-participants on key demographic variables (Galler et al., 2012). Given that this is a 45+ year longitudinal study, the ability to locate and enroll this number of the original cohort can be considered a strength.

In summary, we found that Barbadian children who had experienced moderate-severe malnutrition in infancy were also more likely to have experienced maltreatment during childhood, particularly neglect. Further studies are needed to investigate the impact of this relationship and whether this finding is also present in other populations. These findings highlight the importance of studying early adversity exposures in context—recognizing that adversities like maltreatment and malnutrition often co-occur. Moreover, etiologies, interrelations, and interactions of early adversity are complex and may vary by context, indicating a need for further research on these topics globally.

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Table 1Participant characteristics (*n* (%) or mean $\pm$ SD).

	Total Sample	Malnutrition	Control	<i>p</i>-value
<i>N</i>	139	77	62	--
Female	66 (47.5)	37 (48.1)	29 (46.8)	0.881
Age at CTQ-SF report (yrs)	43.8 $\pm$ 2.3	44.1 $\pm$ 2.1	43.4 $\pm$ 2.4	0.061~
Birth weight (g)	2917.3 $\pm$ 430.9	2971.6 $\pm$ 444.0	2849.9 $\pm$ 407.6	0.098~
Maternal age at birth (yrs)	24.2 $\pm$ 7.2	24.5 $\pm$ 7.2	23.9 $\pm$ 7.1	0.679
Standard of Living (5–11 yrs)	−0.6 $\pm$ 0.9	−0.9 $\pm$ 0.9	−0.3 $\pm$ 0.5	<0.001
Standard of Living (9–15 yrs)	0.5 $\pm$ 0.9	0.2 $\pm$ 0.9	0.7 $\pm$ 0.8	<0.01
Standard of Living (11–17 yrs)	0.3 $\pm$ 0.7	0.1 $\pm$ 0.7	0.6 $\pm$ 0.6	<0.01

Note: *P*-values obtained from t-tests and Wilcoxon rank-sum tests for continuous variables, Chi-square tests for categorical variables.Items bolded if $p < 0.05$;~ if $p < 0.10$.

Table 2

Factor analysis of the CTQ-SF in the BNS cohort ($N=139$), showing source of questionnaire items and factor loadings >0.45

		Loadings		
	CTQ Subscale	Factor 1	Factor 2	Factor 3
Factor 1: Physical and emotional abuse ($\alpha=0.88$)				
Hit hard and had bruises (Q11)	PA	0.80		
Someone noticed participant hit or beaten (Q17)	PA	0.77		
Parents wished never born (Q8)	EA	0.72		
Believe was physically abused (Q15)	PA	0.69		
Someone in family hated participant (Q18)	EA	0.67		
Hit hard and saw doctor (Q9)	PA	0.63		
Believe was emotionally abused (Q25)	EA	0.61		
Punished with hard object (Q12)	PA	0.55		
Insulted by family members (Q14)	EA	0.53		
Called names by family members (Q3)	EA	0.46		
Factor 2: Sexual abuse ($\alpha=0.95$)				
Molested (Q24)	SA		0.90	
Forced to do sexual things (Q23)	SA		0.90	
Believe was sexually abused (Q27)	SA		0.89	
Touched or made to touch in sexual way (Q20)	SA		0.89	
Threatened unless did something sexual (Q21)	SA		0.85	
Factor 3: Emotional and physical neglect ($\alpha=0.83$)				
Felt loved (Q7)	EN			0.71
Support from family (Q28)	EN			0.68
Someone took me to doctor (Q26)	PN			0.68
Felt close (Q19)	EN			0.65
Felt special (Q5)	EN			0.65
Family members looked out for each other (Q13)	EN			0.62
Felt taken care and protected (Q2)	PN			0.55
Not enough food (Q1)	PN			0.53

Note: Cronbach's alphas are standardized.

Abbreviations: physical abuse (PA), emotional abuse (EA), sexual abuse (SA), emotional neglect (EN) and physical neglect (PN)

Infant malnutrition as a predictor of childhood abuse and neglect subscales and factor scores using the Childhood Trauma Questionnaire-Short Form (CTQ-SF)

Table 3

	Malnutrition N=77	Control N=62	β , SE Unadjusted	p- value	β , SE Adjusted	p-value
CTQ-SF Subscales						
Physical Abuse	7.3 $\pm$ 3.3	7.1 $\pm$ 2.4	0.2 $\pm$ 0.5	0.750	0.2 $\pm$ 0.4	0.713
Emotional Abuse	6.6 $\pm$ 4.2	6.5 $\pm$ 4.3	0.4 $\pm$ 0.7	0.593	0.3 $\pm$ 0.6	0.589
Sexual Abuse	7.9 $\pm$ 4.2	7.5 $\pm$ 3.3	0.1 $\pm$ 0.7	0.848	-0.2 $\pm$ 0.8	0.810
Emotional Neglect	8.1 $\pm$ 3.3	6.7 $\pm$ 2.3	1.4 $\pm$ 0.7	0.059	1.1 $\pm$ 0.8	0.160
Physical Neglect	10.2 $\pm$ 4.8	8.8 $\pm$ 3.5	1.4 $\pm$ 0.5	0.004	1.0 $\pm$ 0.5	0.035
Total CTQ Score	40.1 $\pm$ 15.4	36.6 $\pm$ 9.6	3.5 $\pm$ 2.2	0.121	2.4 $\pm$ 2.2	0.284
CTQ-SF Factors						
Factor 1: PA/EA	-0.003 $\pm$ 1.1	0.004 $\pm$ 0.8	-0.01 $\pm$ 0.2	0.970	-0.1 $\pm$ 0.1	0.409
Factor 2: SA	0.003 $\pm$ 0.9	-0.004 $\pm$ 1.1	0.0 $\pm$ 0.2	0.965	-0.1 $\pm$ 0.2	0.732
Factor 3: PN/EN	0.19 $\pm$ 1.1	-0.23 $\pm$ 0.73	0.4 $\pm$ 0.2	0.013	0.3 $\pm$ 0.2	0.057

Note: Means $\pm$ SE (first two columns) and results of generalized linear regression models (last four columns); Adjusted models account for childhood standard of living.