The Journal of Child Psychology and Psychiatry

Journal of Child Psychology and Psychiatry 62:6 (2021), pp 751–761 doi:10.1111/jcpp.13312

Classifying childhood war trauma exposure: latent profile analyses of Sierra Leone's former child soldiers

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Background: Former child soldiers are at elevated risk for mental health problems (e.g., traumatic stress, emotion dysregulation, and internalizing and externalizing problems). To examine which groups of former child soldiers are more likely to have difficulties with emotion regulation, interpersonal relationships, and mental health postconflict, we explored patterns of war trauma exposure and their effects on subsequent mental health problems among former child soldiers in Sierra Leone. **Methods:** Participants were 415 (23.86% female) Sierra Leonean former child soldiers participating in a 15-year, four-wave longitudinal study. At T1 (2002), 282 former child soldiers (aged 10–17) were recruited. T2 (2004) included 186 participants from T1 and an additional cohort of self-reintegrated former child soldiers (NT2 = 132). T3 (2008) and T4 (2016/2017) participants were youth enrolled in previous waves (NT3 = 315; NT4 = 364). Latent profile analysis (LPA) was used to classify participants based on the first-time reports of eight forms of war exposure (separation and loss of assets, parental loss, loss of loved ones, witnessing violence, victimization, perpetrating violence, noncombat activities, and deprivation). ANOVA examined whether patterns of war exposure were associated with sociodemographic characteristics and mental health outcomes between T1 and T4. **Results:** LPA identified two profiles: higher exposure versus lower exposure, using cumulative scores of eight forms of war-related trauma exposure. The 'higher war exposure' group comprised 226 (54.5%) former child soldiers and the 'lower war exposure' group included 189 (45.5%). Significantly higher levels of violence-related and combat experiences characterized the group exposed to more traumatic events. The 'higher war exposure' group reported more PTSD symptoms at T2, more hyperarousal symptoms across all waves, and more difficulties in emotion regulation at T4. **Conclusions:** Former child soldiers exposed to higher levels of war-related traumatic events and loss should be prioritized for mental health services immediately postconflict and as they transition into adulthood.
Keywords: Childhood war trauma; former child soldiers; latent profile analysis; mental health outcomes; PTSD.

Introduction

Child exposure to conflict-related violence, particularly the involvement of children with armed groups, usually by force or abduction (i.e., 'child soldiers'), is a serious humanitarian issue (United Nations, 2013a; Wolf, Prabhu & Carello, 2019), and the number of child soldiers continues to increase (NATO, 2011; United Nations, 2013b, 2018). Many child soldiers report being forced to perpetrate violence and witnessing and/or being victimized by violent acts, including physical injury, rape, torture, and killing (Betancourt, Agnew-Blais, Gilman, Williams, & Ellis, 2010; Betancourt, Brennan, Rubin-Smith, Fitzmaurice, & Gilman, 2010; Betancourt et al., 2020).

Layne et al. (2014) have articulated a concept of 'risk factor caravans' in which exposure to risks to psychosocial well-being, such as traumatic events, co-occur, accumulate, and cascade over time to negatively impact youth development and health outcomes throughout the lifespan. Former child soldiers may be at particularly high risk for both short- and long-term mental health problems and impairments in social functioning (Betancourt, McBain, Newnham, & Brennan, 2014; Betancourt, Newnham, McBain, & Brennan, 2013; Betancourt et al., 2020). Although the association between childhood war exposure and adverse mental health outcomes is well documented (Attanayake et al., 2009; Betancourt, Borisova, Soudiere, & Williamson, 2011; Slone & Man, 2016), the longer-term, cumulative and cascading effects of multiple and/or different types of war traumas on mental health over time are less studied. Further research is needed to better understand which groups of former child soldiers are more likely to have difficulties with emotion regulation, interpersonal relationships, and mental health postconflict.

Previous studies have shown that not all former child soldiers report sustained mental health problems in postconflict settings (e.g., Betancourt, Brennan, & Rubin-Smith et al., 2010; Betancourt, McBain, Newnham, et al., 2013; Betancourt et al., 2020; Punamäki, Palosaari, Diab, Peltonen, & Qouta, 2015). Research has identified patterns of postconflict social factors (e.g., trajectories of stigma, community, and family acceptance) that differentiated long-term mental health among former child soldiers (Betancourt et al., 2020). Given that former

Conflict of interest statement: No conflicts declared.

child soldiers were often exposed to different forms of traumatic events and different cumulative numbers of events (Betancourt, Agnew-Blais, Gilman et al., 2010; Newnham, Pearson, Stein, & Betancourt, 2015), it may be that their war experiences exhibit different patterns and different associations with mental health outcomes and social functioning.

According to the chains of risk model, traumatic events may co-occur (Creamer, Burgess, & Mcfarlane, 2001; Finkelhor, Turner, Ormrod, & Hamby, 2009; Steel, Silove, Bird, McGorry, & Mohan, 1999), and exposure to multiple traumas may reflect an interrelated pattern (Rees et al., 2011; Steel et al., 1999). Under the assumption that trauma experiences may exhibit patterns, as opposed to occurring at random (O'Donnell et al., 2017), a person-centered approach, which groups individuals into classes of exposure, may better differentiate the interrelated patterns of trauma exposure (Ho et al., 2019; Merians et al., 2019; Schilling et al., 2016; Slopen et al., 2012). In a recent systematic review of person-centered studies of trauma exposure, all studies identified a group of individuals with a higher level of exposure to a range of trauma types, which consistently exhibited worse psychiatric outcomes than other groups (O'Donnell et al., 2017). A person-centered approach can capture profiles of former child soldiers whose war exposure pattern (in types and number) is similar within a specific profile but different across profiles.

In the current study, we treat war exposures as composite variables indicating the number of exposures to a relatively comprehensive list of indicators of specific types of war trauma (Netland, 2001) because it has the potential to identify a dose–response relationship between war exposures and psychological well-being, while also accounting for the differential impact types of exposures might have on mental health (Netland, 2005). This approach addresses limitations in other approaches. For example, factor-analytic techniques, which group exposures with the assumption that certain exposures share a common latent factor that impacts mental health (Bollen & Bauldry, 2011; Grace & Bollen, 2008), may lead to the exclusion of war exposures that are causal indicators of war trauma but are not correlated with other events from analysis, in particular because the underlying assumption that a latent variable underlies specific traumas is untenable (MacKenzie et al., 2005; Netland, 2005). The sum score approach using summary stressor scores as predictors of mental health is unable to assess the differential impact certain exposures may have on long-term mental health outcomes (Barenbaum et al., 2004).

The present analysis from a prospective four-wave longitudinal study of war-affected youth (LSWAY) used latent profile analyses (LPA; Clogg, 1995; Marsh, Lüdtke, Trautwein, & Morin, 2009) to identify heterogeneous patterns of war trauma (integration of types and number) among former child soldiers in Sierra Leone and examine demographics, emotion regulation skills, intimate partner violence, and mental health to evaluate whether different groups of war exposure are characterized by similar symptom presentations.

Method

Procedures

The present analysis included data from the four-wave LSWAY conducted in postconflict Sierra Leone from 2002 to 2016/2017. The original sample was recruited from five districts in Sierra Leone: Bombali, Kenema, Kono, Moyamba, and Pujehun. In 2002 (T1), youth between the ages of 10 and 17 who were abducted/forced into armed groups and who had contact information available through Disarmament, Demobilization, and Reintegration registries of our collaborating nongovernmental organization (NGO; $N = 259$) and a door-to-door sample of youth ($N = 136$) were approached and invited to participate. At T2 (2004), only 56.88% of the T1 sample was reassessed when the study was stopped due to the death of the NGO country director, but many were relocated in T3 (2008). An additional cohort of self-reintegrated former child soldiers was recruited in Makeni at T2 ($N = 127$). At T3 and T4 (2016/2017), we recontacted youth enrolled in earlier waves (see Participants). There were 529 war-affected youth in the LSWAY data across four waves, including 460 former child soldiers and 69 noncombatants. Data were collected through in-home, one-on-one interviews conducted by Sierra Leonean research assistants trained and supervised by the study principal investigator and research staff. Additional information on the sample and procedures is available in prior publications (Betancourt, Brennan, Rubin-Smith et al., 2010). The study was approved by the Institutional Review Boards at Boston University Medical School/Boston Medical Center, the Harvard T. H. Chan School of Public Health, Boston College, and the in-country Sierra Leone Ethics and Scientific Review Committee.

Participants

The present sample only includes 415 of the 529 Sierra Leonean youth who were former child soldiers ($n_{male} = 316$, 76.14%) and reported war exposures (see Measures) in LSWAY, with the exclusion of 69 noncombatants ($n = 69$) and 45 former child soldiers who did not provide response on war experiences. Within the sample, 327 (aged 10–17, $Mean_{T1age} = 14.42$, $SD_{T1age} = 2.46$) reported data at T1 (2002), 318 ($Mean_{T2age} = 16.49$, $SD_{T2age} = 2.63$) participated in T2 (2004), 317 were reassessed ($Mean_{T3age} = 20.91$, $SD_{T3\ age} = 3.28$) at T3 (2008), and 364 were re-interviewed at T4 (2016/2017) ($Mean_{T4\ age} = 27.95$, $SD_{T4\ age} = 3.58$). Detailed demographic characteristics of the sample are displayed in Table 1.

Measures

Childhood war exposure. Childhood war exposure among former child soldiers was measured using items adapted from the Child war trauma Questionnaire (CWTQ; Macksoud & Aber, 1996), first introduced to the LSWAY in 2004 (T2). The CWTQ assesses the occurrence of 40 different types of war exposure dichotomously (e.g., 'Were you/have you ever been forced to separate from your parents or your primary caregivers because of the war?'). Based on previous research on trauma categories, eight forms of trauma exposure were distilled from the 40 CWTQ types (Macksoud & Aber, 1996; Netland, 2005). The eight forms of trauma exposure were as

Table 1 Characteristics of the sample

	All participants (N_{all} = 415; n_{T4} = 315)	Female participants (n_{all} = 99; n_{T4} = 82)	Male participants (n_{all} = 316; n_{T4} = 233)
Demographics			
Age at T1 (2002), mean (*SD*), *N* = 415	14.42 (2.46)	13.98 (2.54)	14.56 (2.42)
Male, *N* = 415	316 (76.14%)	—	—
Ever received education *n* (%), *N* = 415	378 (91.08%)	81 (81.82%)	297 (93.99%)
Age abducted/forced into armed groups, *N* = 415	10.85 (3.14)	11.01 (3.46)	10.81 (3.06)
Years in armed groups, mean (*SD*), *N* = 415	2.61 (2.59)	1.60 (2.59)	2.82 (2.32)
Worked or self-employed at T4 (*n* = 315), n (%)	72 (22.86%)	18 (21.95%)	54 (23.18%)
Ever made money post war at T4 (*n* = 315), n (%)	150 (47.62%)	42 (51.22%)	108 (46.35%)
Were married or have a partner at T4 (*n* = 315), *n* (%)	154 (48.89%)	35 (42.68%)	119 (51.07%)
Has biological children by T4 (*n* = 315), *n* (%)	200 (63.49%)	66 (80.49%)	137 (58.80%)
Christians at T4 (*n* = 315), *n* (%)	116 (36.83%)	36 (43.90%)	80 (34.33%)
Muslims at T4 (*n* = 315), *n* (%)	104 (33.02%)	34 (41.46%)	70 (30.04%)
Missing on religion at T4 (*n* = 315), *n* (%)	95 (30.16%)	12 (14.63%)	83 (35.63%)

follows: loss of assets and separation, loss of parent(s), loss of loved ones, witnessing of violence, victimization of violence, nonviolent combat activities, perpetration of violence, and deprivation. The categorization involved two processes. First, we distinguished traumas based on level of 'toxicity'. For example, we examined 'loss of parents' and 'loss of loved ones' as separate forms of trauma based on hypothesizing that these events would have differential impact on study participants. Second, we grouped forms of violence relevant to violence exposure based on the roles (perpetrator, witness, or victim) of the participants in these violent experiences.

At T2, 317 out of the 415 responses of war exposure were collected. Any participant who did not complete the questionnaire at T2 was administered the questionnaire at T3 (*n* = 92) or T4 (*n* = 52). For participants (*n* = 36) who reported on war exposures at more than one time point, we only included their first reported response for analysis. In the present analyses, the 40 individual items were dummy coded (No = 0, Yes = 1) and the cumulative scores of items within each form of trauma were computed. These continuous variables were used in LPA models to identify the best grouping solution for trauma exposure.

Psychosocial outcomes. Psychosocial outcomes included post-traumatic stress disorder (PTSD) symptoms, internalizing problems, externalizing problems, emotion regulation, and intimate partner violence (IPV). PTSD symptoms, including re-experiencing symptoms, hyperarousal symptoms, and avoidance, were assessed using the nine-item version of the Post-Traumatic Stress Disorder Reaction Index (PTSD-RI; Steinberg, Brymer, Decker, & Rynoos, 2004). Responses to each item were measured on a five-point scale ranging from 0 ('Not experienced') to 4 ('Almost daily'). Internal consistency of overall PTSD symptoms at each time was good: T2 α = 0.87, T3 α = 0.83, and T4 α = 0.84. The three types of PTSD symptoms (three items on each) showed typically acceptable alphas at most waves ($\alpha > 0.60$) except for avoidance at T2 (α = 0.53) and hyperarousal symptoms at T3 (α = 0.59). A total score of 17 was used as a cutoff score to identify individuals who were above the clinical threshold.

Internalizing problems were assessed with the Hopkins Symptom Checklist-25 (HSCL-25), a measure of depression/anxiety symptoms that has been previously validated for use among adults in sub-Saharan Africa (Bolton, 2001) and adapted to Sierra Leone (Betancourt et al., 2011). Responses to each item ranged from 1 ('Not at all') to 4 ('Extremely'). Participants reported internalizing problems from T2 to T4. Cronbach's alphas of internalizing problems are as follows: T2 α = 0.93, T3 α = 0.87, and T4 α = 0.91.

Externalizing problems were measured by 11 items in a subscale of the Oxford Measure of Psychosocial Adjustment (OMPA; MacMullin & Loughry, 2004) from T1 through T4. Items were scored on a 4-point scale from 1 ('Never') to 4 ('Always'). This subscale showed acceptable or good internal consistency: T1 α = 0.72, T2 α = 0.86, T3 α = 0.79, and T4 α = 0.72.

Emotion regulation was measured with 24 items from the original scale (36 items) of Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) at T4. Reverse-worded items (indicating positive emotion regulation) and another item were not included in the survey because they did not perform well in a pilot study. The adapted version of DERS assessed nonacceptance of emotional responses, difficulty engaging in goal-directed behavior, impulse control difficulties, limited access to emotion regulation strategies, and lack of emotional clarity. Participants responded to each item on a 5-point scale from 1 ('Almost never') to 5 ('Almost always'). Higher scores indicate greater difficulties in emotion regulation. Internal consistency for the DERS in the present analysis was high (α = 0.93). The mean score of all items was used in the analyses.

Participants were asked to report experiences of perpetrating intimate partner violence (IPV) on a list of 'Yes/No' questions at T3 and T4. These questions were adapted from the conflict tactics scale (CTS; Straus, 2017) and a scale on inter-partner agreement (Moffitt et al., 1997). Cronbach's alphas of perpetrating IPV were acceptable (T3 α = 0.79; T4 α = 0.68).

Statistical analyses

First, descriptive analyses were used to report the sociodemographic characteristics and war exposure experiences of the sample. We estimated means, standard deviations (*SD*s), and 95% confidence intervals (CIs) of all measures. Second, LPA was conducted to identify latent profiles of traumatic experiences during the war among former child soldiers, adjusting for gender and duration of time in the armed groups (i.e., estimating logistic regression odds ratios of each profile on

gender and years). Primary analyses included a series of LPA solutions using the cumulative scores of items within each form of trauma exposure. To confirm that this method of analysis did not obscure important detail of traumatic war exposures, results of alternative LPA solutions using individual trauma items (dummy coded scores of the 40 CWTQ items) were also estimated as comparisons. Finally, based on data integrating the classes of war exposure and indicators of psychosocial outcomes assessed from at least one wave, we used ANOVA (for continuous variables) or chi-square tests (for categorical variables) to examine whether the latent profiles of war exposures were associated with any sociodemographic characteristics or mental health outcomes. We examined differences in the mean (or sum) scores of each psychosocial outcome variable (i.e., PTSD, rates above PTSD clinical threshold, specific types of PTSD symptoms, emotion regulation, internalizing problems, and IPV perpetration) at each time point by latent patterns of exposure with ANOVA or chi-square tests. For emotion dysregulation, the analysis was conducted only at T4. Descriptive analyses and ANOVA or chi-square tests were conducted in SPSS 25.0 (IBM Corp, 20172017). LPA was performed using Mplus 7.4 (Muthén & Muthén, 2011).

In the LPA, we tested profile solutions ranging from two to three latent profiles for each scoring method of trauma exposure (i.e., cumulative scores of eight forms of trauma as the primary analysis and binary scores of the 40 individual items as a comparison). Four models (A, B, C, and D) were estimated for each latent profile solution (Pastor, Barron, Miller, & Davis, 2007). Model A allowed variance to differ across indicators (i.e., eight forms of trauma if the cumulative scoring method was estimated) but constrained variance to be equal across classes and constrained covariance to 0. With these parameters, the means of indicators can differ within classes but are the same across classes, and indicators are unrelated to each other within or across classes. Model B allowed variance to differ across binary indicators and classes, and all covariance was constrained to 0. Model C allowed variance to differ across binary items and classes, and it allowed different correlations among indicators within classes, but constrained covariance to be equal across classes. Model D allowed variances and covariance to differ across indicators and classes (Pastor, et al., 2007).

We used several statistical indices to assess goodness of fit for the LPA models, including the sample-adjusted Bayesian information criterion (BIC) and the Lo–Mendell–Rubin (LMR) likelihood ratio test (Pastor et al., 2007). The BIC is an indicator of global fit and is used to compare models with different numbers of profiles and/or specifying different parameterizations. Lower BIC scores indicate better fitting models (Pastor et al., 2007). LMR is a significance test used to compare competing models having the same parameterization. If LMR is significant, this supports selection of the more complex solution (more profiles); thus, the solution with a nonsignificant LMR is the best fitting. We used the sample-size adjusted BIC as a more favorable index over other indices because it can be used to compare the fit of any model, regardless of the parameterization used or the number of profiles specified (Nylund, Asparouhov, & Muthén, 2007). We also reported the average classification probabilities (good classification quality would yield probabilities > 0.80; Clogg, 1995) and examined entropy (ranged from 0 to 1) as an index of the classification quality, where values approaching 1 indicate clear separation of profiles (Celeux & Soromenho, 1996).

Results

Characteristics of the sample

Characteristics of the sample are displayed in Table 1. The average age of the sample at T1 (2002) was 14.42 (*SD* = 2.46, 95% CI = 14.18 to 14.66). The sample was predominantly male (76.14%, *n* = 316) and completed some education (91.08%, *n* = 378). The average age abducted/forced into armed groups was 10.85 (*SD* = 3.14, 95%CI = 10.65 to 11.31). The average duration enrolled in fighting forces was 2.61 years (*SD* = 2.59, CI = 2.36 to 2.86), and male participants (*mean* = 2.82, *SD* = 2.32, 95% CI = 2.62 to 3.18) reported longer enrollment in fighting forces than females (*mean* = 1.60, *SD* = 2.59, 95% CI = 1.15 to 2.21). Among participants (*n* = 315) at T4, 72 (22.86%) were employed and 150 (47.62%) made money at some point following the war. Approximately half of the sample (48.89%, *n* = 154) were married or had a partner at T4. By T4, 200 (63.49%) had biological children.

Nearly all participants reported ever being forced to move (*n* = 399, 96.14%) and being separated from parents (*n* = 398, 95.90%), and a majority of the sample reported ever being without food (*n* = 350, 84.34%) or shoes/clothes/shelter during the war (*n* = 322, 77.59 %). The prevalence of witnessing or being a victim of different forms of violence (e.g., intimidation, beating or torture, violent physical injury, and killing) was higher than 40%. The prevalence of injuring/killing an acquaintance, close friend, and extended or core family members, committing rape, or being chopped or stabbed were all lower than 10%. Further information about the prevalence of trauma experiences is presented in Table S1. Table 2 presents the cumulative trauma experiences of the eight forms of war exposure for the whole sample and by gender. Results of one-way ANOVA showed no gender differences in any form of trauma exposure.

Latent profiles of war-related trauma exposure

Four LPA models (Models A1, B1, C1, and D1) were estimated for a two- and three-profile solution, respectively, with the eight forms of cumulative war trauma, controlling for gender and years in armed groups. Model fit statistics for these models are presented in Table S2. With the exception of Model D1 of the three-profile solution (not converged), the model fit statistics were acceptable. Among these models, Model B1 of the two-profile solution showed the best fit: sample-size adjusted *BIC* = 8622; *LMR* = 470.65, $p < .001$. The entropy was 0.79, and the average classification probabilities ranged from 0.93 to 0.94.

To investigate whether Model B2 of the two-profile solution identified in the primary analysis was more optimal, we compared its model fit (i.e., sample-size adjusted BIC) with models estimated using an alternative approach (i.e., individual trauma experiences). In the alternative LPA, four models (Models A2, B2, C2, and D2) for a two- and three-profile solution, respectively, were estimated with the 40 binary CWTQ items, controlling for gender and years

Table 2 Descriptive analyses of eight categories of trauma exposure

	All participants (N_{all} = 415) mean (*SD*), [95%CI]	Female participants (N_{all} = 99) mean (*SD*), [95%CI]	Male participants (N_{all} = 316) mean (*SD*), [95%CI]	*F*	*p*	Cohen's *d*
Separation and loss of assets (0–3)	2.30 (0.54), [2.24, 2.35]	2.23 (0.53), [2.12, 2.33]	2.32 (0.54), [2.26, 2.38]	2.11	.15	0.17
Loss of parents (0–2)	0.40 (0.61), [0.34, 0.47]	0.46 (0.62), [0.33, 0.58]	0.38 (0.61), [0.31, 0.46]	0.97	.32	0.13
Loss of loved ones (0–5)	1.25 (0.96), [1.15, 1.35]	1.23 (1.00), [1.02, 1.44]	1.25 (0.95), [1.14, 1.35]	0.04	.84	0.02
Witnessing Violence (0–4)	2.47 (1.25), [2.35, 2.59]	2.66 (1.10), [2.44, 2.88]	2.41 (1.29), [2.27, 2.55]	2.93	.09	0.20
Victimization of violence (0–13)	4.12 (2.91), [3.83, 4.40]	4.58 (3.18), [3.95, 5.22]	3.97 (2.81), [3.66, 4.29]	3.29	.07	0.21
Nonviolent combat activities (0–4)	1.82 (1.13), [1.71, 1.93]	1.73 (1.11), [1.51, 1.96]	1.85 (1.14), [1.72, 1.98]	0.84	.36	0.11
Perpetration of violence (0–7)	0.73 (1.14), [0.63, 0.91]	0.59 (1.03), [0.37, 0.80]	0.77 (1.18), [0.63, 0.91]	1.73	.19	0.16
Deprivation (0–3)	2.04 (0.90), [1.95, 2.13]	2.09 (0.88), [1.91, 2.26]	2.02 (0.91), [1.92, 2.13]	0.32	.58	0.08

in armed groups. Model fit statistics are presented in Table S2. Model A2 of the two-profile solution showed acceptable model fit statistics: sample-size adjusted *BIC* = 12,360; *LMR* = 1,389.80, $p < .001$. The entropy was 0.90, and the average classification probabilities ranged from 0.97 to 0.98. However, our comparison indicated that Model B1 of the two-profile solution for eight forms of trauma was more optimal because it had a smaller sample-size adjusted BIC and exhibited greater differences in traumas types or forms across captured profiles. Figure 1 displays the patterns of childhood war exposure captured in Model B1.

In Model B1, one of the two profiles (n = 226, 54.46 % of the sample) was categorized as 'higher exposure', exhibiting higher exposure to all eight forms of trauma (*F*s ranged from 10.32 to 459.90, p ranged from .000 to .001, Cohen's d ranged from 0.32 to 2.13), particularly witnessing violence [mean difference = 1.46, $F(1, 408) = 208.73$, $p = .001$, 95% CI = 1.50 to 1.43, Cohen's $d = 1.43$], violence victimization [mean difference = 4.26, $F(1, 406) = 459.90$, $p < .001$, 95% CI = 4.19 to 4.32, Cohen's $d = 2.13$], and nonviolent combat activities [mean difference = 4.26, $F(1, 402) = 240.06$, $p < .001$, 95% CI = 1.37 to 1.42, Cohen's $d = 1.55$]. The other profile was labeled as 'lower exposure' (n = 189, 45.54 % of the sample), indicating low exposure to all forms of trauma. The results of Model B1 of the two-profile solution also showed that the logistic regression odds ratios of each profile (higher exposure or lower exposure) on gender and years in armed groups ranged from 0.26 to 0.87 (<1.0), indicating that the likelihood of participants' membership in the two latent profiles was not associated with gender or years in armed groups. Detailed comparison of these characteristics between higher and lower war exposures is presented in Table 3.

Sociodemographic characteristics and psychosocial adjustment of former child soldiers by their war exposure patterns

Next, we conducted one-way ANOVAs or chi-square to examine the differences in sociodemographic characteristics and psychosocial adjustment of former child soldiers over time between the higher war exposure group and the lower war exposure group. Table 3 presents the descriptive results (means, *SD* or n, %) of each outcome for each group. Compared to former child soldiers who were exposed to lower levels of war trauma, those associated with higher war exposure were involved in armed groups at an older age [$F(1, 321) = 5.47$, $p = .02$, Cohen's $d = 0.26$], reported relatively more difficulties in emotion regulation at T4 [$F(1,310) = 2.88$, $p = .09$, Cohen's $d = 0.19$], had more PTSD symptoms at T2 [$F(1,316) = 18.98$, $p < .001$, Cohen's $d = 0.41$], and were more likely to experience PTSD above the likely clinical threshold [$\chi 2(1, 308) = 14.47$, $p < .001$, odds ratio = 2.69]. The higher exposed group reported higher scores in all types of PTSD symptoms at T2 and higher hyperarousal symptoms at T3 [$F(1,363) = 6.92$, $p = .01$, Cohen's $d = 0.27$] and T4 [$F(1,314) = 3.13$, $p = .08$, Cohen's $d = 0.20$]. Figure 2 presents the differences in key psychosocial outcomes by war exposure patterns.

Discussion

We present an in-depth investigation of war exposures in a longitudinal sample of former child soldiers in Sierra Leone. Using LPA, we identified two profiles of war-related trauma exposures of former child soldiers using cumulative exposure scores of eight distinct forms of trauma. The higher exposure group contained 226 (54.46%) participants, and the lower exposure group included 189 (45.54%) individuals with similar sociodemographic characteristics, with the exception of age at enrollment in armed forces. The higher exposure group reported more exposure to all eight categories of trauma and loss, particularly to witnessing violence, violence victimization, and non-conflict combat activities. In terms of mental health outcomes, those in the higher exposure group were more likely to meet criteria PTSD at T2 that was in the range of a clinical disorder. Individuals in the higher exposure group also reported more difficulties in emotion regulation in 2016/2017 (T4), the first time this was assessed in this sample.

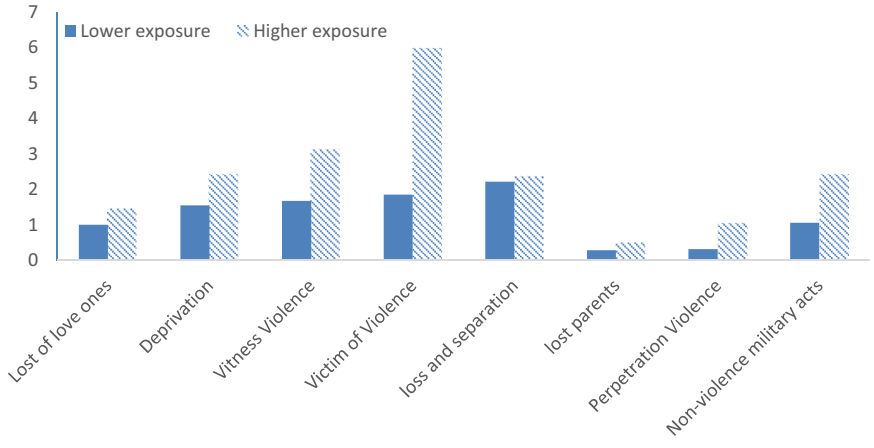

Figure 1 Patterns of war exposure among former child soldiers [Colour figure can be viewed at wileyonlinelibrary.com]

Our results align with existing research on the cumulative relationship between war trauma and PTSD symptoms. Several studies have found correlations between the overall number of war exposures and both symptoms of post-traumatic stress and severity of post-traumatic stress disorder (Gupta & Zimmer, 2008; Mels et al., 2010; Nooner et al., 2012; Pfeiffer & Elbert, 2011). Our findings build on this work by integrating a person-centered approach that identified patterns (i.e., distinct groupings of traumatic experiences) as opposed to a sum of exposures to all traumatic events. Although this approach does not identify people in need of diagnostic treatments and the differences in PTSD symptoms by patterns of war exposure fade over time, findings have important implications for mental health workers and other service providers working with former child soldiers or other war-exposed youth. Adopting early screening, monitoring, and follow-up practices to identify those exposed to greater levels of trauma and loss, and particularly those with the most direct experience with violent acts, such as witnessing violence or experiencing violent victimization, could accelerate linkages to trauma-informed psychosocial support services and provide a foundation for strengthening, scaling, and sustaining systems of evidence-based treatments in low- and middle-income countries (LMICs). Additionally, findings indicating that those with higher war exposure reported more long-term emotion regulation difficulties and hyperarousal symptoms extend prior research showing that trauma-exposed children and adolescents with a PTSD diagnosis report greater emotion regulation difficulties than those without a PTSD diagnosis (Villalta et al., 2018). History of childhood maltreatment has also been shown to predict difficulties in emotion regulation and PTSD diagnosis among adults (Cloitre et al., 2005). Given that emotion regulation has been identified as a transdiagnostic mechanism linked with the intergenerational transmission of trauma, violence, and PTSD (Pat-Horenczyk et al., 2015), focusing on improving emotion regulation skills among former child soldiers with greater war exposure could help improve both their own mental health and functioning as well as that of their children.

The current study also expands existing research on person-centered approaches to modeling trauma by focusing on a sample of former child soldiers. Of the 17 studies reviewed in a recent meta-analysis on trauma exposure, none focused on samples of war-affected youth or youth involved in military or armed groups more specifically (O'Donnell et al., 2017). Our findings suggest that the application of LPA to research on war-affected populations is a promising strategy to build a more nuanced understanding of the relationship between these exposures and mental health over time. For example, the two-class solution in our research, which divided the sample into roughly equal-sized groups, could suggest that there is overall less variability in patterns of exposure to traumatic events among former child soldiers, who might be exposed to relatively higher levels of trauma compared to the general population. This grouping is consistent with most of the 17 studies reviewed in the meta-analysis on trauma exposure (O'Donnell et al., 2017).

The current study attempted to address gaps in the literature on the differential impact specific exposures may have on long-term mental health outcomes (Barenbaum, Ruchkin, & Schwab-Stone, 2004). Drawing from the concept of 'risk caravans', in which different kinds of trauma can occur at the same time, some kinds of experiences are more toxic than others (Layne, Briggs, & Courtois, 2014). War experiences have shown differential effects on mental health, such that some types of events are more detrimental than others (Layne et al., 2010; Netland, 2005). For example, experiences such as the death of a caregiver or loved one (Betancourt, Newnham, McBain et al., 2013; Duraković-Belko et al., 2003), witnessing violence (Macksoud and Aber, 1996), experiencing life-threatening events (including rape)

Table 3 Comparison of characteristics of postwar assessed measures between profiles identified based on eight categories of trauma

	Lower exposure *n* (%)/mean (*SD*) [CI]	Higher exposure *n* (%)/mean (*SD*) [CI]	F/χ^2	*p*	Cohen's *d*/odds ratio [CI]
N	189 (45.54%)	226 (54.46%)			
Demographics					
Male	150 (79.37%)	166 (73.45%)	1.98	.16	0.72 [0.45, 1.14]
Christians	57 (46.72%)	85 (53.46%)	1.24	.26	0.76 [0.48, 1.23]
Muslims	65 (53.28%)	74 (46.54%)			
Age abducted/forced into armed groups	10.54 (3.13), [10.01, 11.05]	11.33 (2.95), [10.90, 11.77]	5.47	.02	0.26 [0.04, 0.48]
Years in armed groups	2.56 (2.77), [2.17, 2.96]	2.65 (2.43), [2.33, 2.97]	0.11	.74	0.03 [−0.16, 0.23]
Eight forms of trauma					
Separation and loss of assets	2.20 (0.55), [2.12, 2.28]	2.37 (0.52), [2.31, 2.44]	10.32	.001	0.32 [0.12, 0.52]
Loss of parents	0.27 (0.51), [0.19, 0.35]	0.52 (0.66), [0.42, 0.61]	15.26	< .001	0.42 [0.21, 0.63]
Loss of loved ones	1.00 (0.86), [0.87, 1.14]	1.45 (0.99), [1.31, 1.60]	19.81	< .001	0.48 [0.27, 0.70]
Witness violence	1.67 (1.12), [1.51, 1.83]	3.13 (0.93), [3.01, 3.26]	208.73	< .001	1.43 [1.21, 1.65]
Victimization of violence	1.78 (1.62), [1.55, 2.02]	6.04 (2.26), [5.74, 6.34]	459.90	< .001	2.13 [1.89, 2.38]
Nonviolent combat activities	1.04 (0.74), [0.94, 1.15]	2.44 (1.01), [2.31, 2.57]	240.06	< .001	1.55 [1.33, 1.78]
Perpetration of violence	0.33 (0.77), [0.21, 0.45]	1.05 (1.29), [0.86, 1.23]	37.68	< .001	0.66 [0.45, 0.88]
Deprivation	1.54 (0.99), [1.39, 1.69]	2.44 (0.57), [2.36, 2.52]	121.99	< .001	1.15 [0.93, 1.37]
Psychosocial outcomes					
Ever perpetrated IPV (sum score) – T3	2.90 (2.51), [2.12, 3.69]	3.15 (2.68), [2.56, 3.74]	2.24	.63	0.10 [−0.28, 0.47]
Ever perpetrated IPV – T3	25 (54.35%)	52 (62.65%)	0.85	.36	0.71 [0.34, 1.47]
Ever perpetrated IPV(sum score) – T4	1.61 (1.80), [1.19, 2.02]	1.34 (1.64), [1.03, 1.65]	1.08	.30	0.16 [−0.14, 0.45]
Ever perpetrated IPV – T4	46 (62.16%)	64 (57.66%)	3.74	.54	1.21 [0.66, 2.20]
Difficulties in emotion regulation – T4	1.81 (0.63), [1.70, 1.91]	1.93 (0.65), [1.83, 2.03]	2.88	.09	0.19 [−0.04, 0.41]
PTSD symptoms – T2	1.70 (0.42), [1.63, 1.77]	1.93 (0.50), [1.86, 2.01]	18.98	< .001	0.49 [0.27, 0.72]
PTSD symptoms – T3	1.60 (0.41), [1.54, 1.66]	1.67 (0.40), [1.61, 1.72]	2.68	.10	0.17 [−0.03, 0.38]
PTSD symptoms – T4	1.34 (0.87), [1.20, 1.49]	1.44 (0.86), [1.31, 1.57]	1.00	.32	0.12 [−0.11, 0.34]
PTSD (% above clinical threshold) – T2	27 (20.45%)	72 (40.91%)	14.47	< .001	2.69 [1.62, 4.52]
PTSD (% above clinical threshold) – T3	23 (17.16%)	22 (13.41%)	0.81	.37	0.75 [0.40, 1.41]
PTSD (% above clinical threshold) – T4	39 (31.45%)	43 (28.10%)	0.37	.54	0.85 [0.51, 1.43]
Re-experiencing symptoms – T2 PTSD	1.78 (0.55), [1.69, 1.87]	2.05 (0.58), [1.97, 2.14]	18.31	< .001	0.49 [0.27, 0.72]
Hyperarousal Symptoms – T2 PTSD	1.57 (0.51), [1.48, 1.66]	1.89 (0.64), [1.79, 1.98]	22.18	< .001	0.55 [0.32, 0.77]
Avoidance – T2 PTSD	1.76 (0.50), [1.67, 1.84]	1.87 (0.47), [1.80, 1.94]	4.11	.04	0.23 [0.00, 0.45]
Re-experiencing symptoms – T3 PTSD	1.78 (0.54), [1.69, 1.86]	1.82 (0.49), [1.75, 1.89]	0.57	.45	0.08 [−0.13, 0.28]
Hyperarousal Symptoms – T3 PTSD	1.57 (0.39), [1.41, 1.53]	1.58 (0.43), [1.52, 1.64]	6.92	.01	0.27 [0.06, 0.47]
Avoidance – T3 PTSD	1.56 (0.55), [1.48, 1.65]	1.61 (0.50), [1.54, 1.68]	.074	.39	0.10 [−0.11, 0.30]
Re-experiencing symptoms – T4 PTSD	1.60 (1.08), [1.42, 1.78]	1.71 (1.10), [1.54, 1.87]	0.72	.40	0.10 [−0.11, 0.31]
Hyperarousal Symptoms – T4 PTSD	0.88 (0.92), [0.73, 1.04]	1.07 (0.96), [0.93, 1.21]	3.13	.08	0.20 [−0.01, 0.41]
Avoidance – T4 PTSD	1.54 (1.07), [1.36, 1.71]	1.61 (1.01), [1.45, 1.76]	0.35	.55	0.07 [−0.14, 0.27]
Externalizing problems – T1	1.62 (0.44), [1.55, 1.70]	1.58 (0.40), [1.52, 1.64]	1.11	.29	0.10 [−0.31, 0.12]
Externalizing problems – T2	1.74 (0.53), [1.64, 10.83]	1.75 (0.53), [1.67, 1.84]	0.07	.79	0.02 [−0.23, 0.26]
Externalizing problems – T3	1.50 (0.36), [1.44, 1.56]	1.49 (0.35), [1.44, 1.54]	0.03	.87	0.03 [−0.26, 0.20]
Externalizing problems – T4	1.43 (0.37), [1.36, 1.50]	1.44 (0.30), [1.39, 1.49]	0.03	.87	0.03 [−0.21, 0.27]
Internalizing problems – T2	2.01 (0.53), [1.92, 2.10]	2.02 (0.49), [1.96, 2.09]	0.05	.81	0.02 [−0.19, 0.23]
Internalizing problems – T3	1.91 (0.46), [1.83, 1.99]	1.93 (0.43), [1.87, 2.00]	0.34	.56	0.05 [−0.18, 0.27]
Internalizing problems – T4	1.78 (0.50), [1.69, 1.87]	1.73 (0.45), [1.65, 1.80]	0.88	.35	0.11 [−0.35, 0.14]

One-way ANOVA was estimated for continuous measures and mean (standard deviation, *SD*), confidence intervals (CIs), *F* and *p* values, and effect sizes (Cohen's *d*) and CIs of effect sizes were reported; chi-square tests were conducted for discrete measures and *n* (%), χ^2, *p* values, and effect sizes (odds ratio) and CIs of effect sizes were reported.

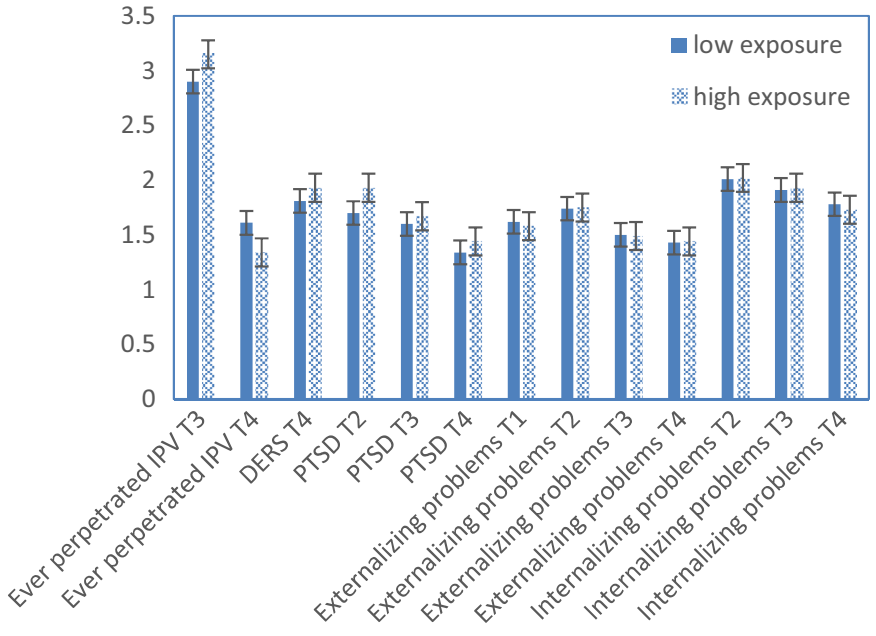

Figure 2 Differences in Key Psychosocial Outcomes by Patterns of war exposure [Colour figure can be viewed at wileyonlinelibrary.com]

(Betancourt et al., 2011; Layne et al., 2010), injuring or killing others (Betancourt et al., 2011), and being forcibly displaced (Duraković-Belko et al., 2003) have been associated with symptoms of depression and PTSD among war-affected youth. Although our findings support a cumulative model of war traumas, with the higher exposure group reporting more traumas than the lower exposure group in all categories, the greatest magnitude of difference was observed in mean scores for the categories of being a victim of violence (6.04 vs. 1.78, respectively), witnessing violence (3.13 vs. 1.67, respectively), and nonconflict military activities (2.44 versus 1.04, respectively). This suggests that experiences such as witnessing violence, being the victim of violence, and engaging in combat activities have more of an impact on psychosocial outcomes than other forms of war-related experiences.

Limitations

There are several limitations to this study that should be noted. Participants' first-report war exposure experiences from T2 through T4 were included in the analyses. This design could lead to potential measurement issues, such as reluctance to disclose and uneven recall intervals during data collection. There were also potential discrepancies in reporting of exposure to war traumas at different data collection time points. If these issues were not at random, the results may also involve bias. For instance, a large number of false positives could lead to overestimating the relationship between war exposures and mental health outcomes; conversely, false negatives could result in underestimating the association. Although we have attempted to mitigate this bias by systematically selecting first-time responses, in some cases as late as 15 years postconflict, future research is needed to address potential bias caused by uneven recall intervals, especially related to time lag. Additionally, although the categorization of trauma exposure was based on extant literature about different forms of trauma experiences (Macksoud & Aber, 1996; Netland, 2005), and the model fit of LPA based on the eight forms of trauma exposure was better than that of individual traumatic experiences, our investigation of different forms of trauma did not examine the variation across traumatic experiences within the same form of exposure. Future research is needed to explore a more optimal solution of categorization and symptom constellations related to war trauma exposure. For example, research could integrate the notion of toxic stress (Betancourt et al., 2011; Betancourt, Newnham, McBain et al., 2013) into the weightings and categorization of war experiences. Finally, due to the almost ubiquitous exposure to some events within our sample, statistical power to detect a significant relationship between certain kinds of traumatic experiences and mental health outcomes is limited. While the current study makes some strides in distinguishing the differential impact of certain types of war trauma experiences on mental health outcomes by examining the magnitude of difference, additional research is needed to better unpack and understand the differential impacts of specific types of war exposures (e.g., violence-related trauma) on mental health over time among war-exposed populations.

Conclusions

Our person-centered analyses of patterns of war experiences represent a promising approach to

enhancing the understanding of war exposure and its potential impact on subsequent mental health outcomes among former child soldiers who were exposed to relatively high levels of trauma and loss during the civil war in Sierra Leone. This approach may also inspire a new direction for war trauma research that involves classifying trauma history. Future research may take a more nuanced approach (integrated person- and variable-centered approaches) to examine more precise associations between war experiences and developmental risks among children associated with armed forces and armed groups, as well as factors leading to resilience in this population. Findings that former child soldiers with higher trauma exposure reported more PTSD symptoms at T2, hyperarousal symptoms across all waves, and difficulties in emotional regulation at T4 have important implications for systems of sustainable psychosocial support services in armed conflict and/or postconflict settings. An early detection of war exposure patterns and individuals with greater, more toxic exposures should be conducted to identify individuals for psychosocial support services focusing on reducing traumatic stress symptoms and improving emotion regulation skills. Given the limited mental healthcare services in LMICs, more sustainable and responsive systems of evidence-based treatments should be established in postconflict settings. Further, those reporting witnessing violence, being the victim of violence, and engaging in combat activities may be at the greatest need for both immediate and ongoing evidence-based mental health and psychosocial support services.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Table S1. Comparison war experiences between profiles identified in Model A1 (N=415).
Table S2. Goodness of fit of LPAs based on all individual items and eight categories of trauma exposure.

Acknowledgements

This study was funded by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (grant # 4R01HD073349-05). The authors extend their gratitude to their participants, as well as the local research assistants who conducted interviews in Sierra Leone, and their project coordinators and colleagues at their collaborating NGO and government partners in Sierra Leone. S.S. had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. The authors have declared that they have no competing or potential conflicts of interest.

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Key points

- Former child soldiers experienced a variety of war traumas.
- Two profiles (lower exposure and higher exposure) of former child soldiers were identified using a person-centered approach (i.e., LPA) based on the cumulative scores of different categories of war exposure.
- Over half of the former child soldiers were exposed to more traumas, characterized by higher levels of violence-related and combat experiences.
- The group exposed to more trauma reported higher levels of PTSD symptoms and had potentially higher levels of DERS at follow-up. These former child soldiers should be prioritized for mental health service immediately postconflict.

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Accepted for publication: 17 July 2020