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The measurement of war-related trauma amongst internally displaced men and women in South Sudan: Psychometric analysis of the Harvard Trauma Questionnaire

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ABSTRACT

Background: Studies from armed conflict settings, including South Sudan, have revealed the deleterious mental health impact of exposure to war atrocities. However, there is little consensus on what is meant by war trauma, how it should be measured, and how levels of trauma vary across men and women.
Methods: We used psychometric analyses to measure war trauma among 1178 internally displaced adults (mean age = 39 years, 50% women) in the Malakal region of South Sudan. We used cross-sectional survey data and applied classical test theory, factor analysis, item response theory, and differential item functioning with the war events subscale (17 items) of the Harvard Trauma Questionnaire (HTQ).
Results: We found good validity and internal consistency reliability for the HTQ. We found evidence for unidimensionality using factor analyses, and item response theory models showed that some war events (like witnessing the killing of family or friends) were more sensitive to the underlying 'war-related trauma' trait than others (like abduction). Differential item functioning analyses revealed that the measure performed differently for men and women, indicating the need for sex-stratified analysis in the measurement of trauma.
Limitations: The use of self-report may lead to recall and response bias, and the study sample may not be representative of the broader population in South Sudan.
Conclusion: This study emphasizes the need for cultural adaptation and psychometric evaluation of commonly used measurement instruments, especially in humanitarian settings where survey data are used to set priorities for mental health and psychosocial support services.

1. Introduction

1.1. The South Sudanese civil war

Studies of civilians caught in humanitarian emergencies, especially conflict-affected settings, have demonstrated the strong association between potentially traumatic war events (PTEs) and high rates of post-traumatic stress disorder (PTSD), anxiety, depression, and substance use (Attanayake et al., 2009; Charlson et al., 2019; Johnson and Thompson, 2008; Murthy, 2007). The South Sudanese Civil War (2013–2020) resulted in the brutal killing of 400,000 people and the displacement of over 4 million civilians, along with severe food shortage, torture, rape, and other forms of violence (Deng et al., 2015; Ng et al., 2017). Although the government and warring factions signed an initial peace agreement in 2015, intense fighting in the region has continued, and studies from South Sudan have revealed high rates of trauma and psychological distress, especially PTSD, in the population (Amusan and Ufuoma, 2020; Ayazi et al., 2012; Deng et al., 2015; Karunakara et al., 2004; Neuner et al., 2004; Pritchard et al., 2019; Tutlam et al., 2020). However, the scales used in these studies were

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developed for use with other populations and have not been systematically validated in the South Sudanese cultural context. The current study examines the psychometric properties of the Harvard Trauma Questionnaire (HTQ) to understand the sources of war-related trauma experienced by internally displaced men and women in South Sudan.

1.2. The Harvard Trauma Questionnaire

The HTQ was originally developed as a screening checklist and validated with Southeast Asian refugees from Vietnam and Cambodia, and comprises items about various witnessed or experienced war atrocities (17 items) and symptoms for PTSD (16 items) (Fawzi et al., 1997; Mollica et al., 1996, 1987). It demonstrates good psychometric properties, with an inter-rater reliability of 0.93, a test-retest reliability of 0.89 ($p<0.0001$), and internal consistency reliability of 0.90 (Hollifield et al., 2002; Mollica et al., 1992; Sigvardsdotter et al., 2016a). Since then, it has been widely adapted and used across cultures, including South Sudan (Ayazi et al., 2013; Ng et al., 2017; Roberts et al., 2009a; Sigvardsdotter et al., 2016b), and demonstrated acceptable psychometric properties, although mainly for its PTSD subscale (Rasmussen et al., 2015, 2007; Tay et al., 2017). Given that the HTQ is cheaper and easier to administer than clinical interviews, its use has become increasingly popular in humanitarian settings (Krynen et al., 2013). However, its trauma exposure items are usually used to create a sum score for number of events experienced, which assumes that all items provide the same information, and there is a gap in the theoretical understanding of levels of underlying trauma represented by these items.

1.3. Classical test theory and item response theory

Potentially traumatic war events (PTEs) range in their diversity and impact across populations, comprising atrocities like torture, sexual assault, witnessing violence, starvation, and abduction (Amstadter and Vernon, 2008; Arnetz et al., 2014; Hollifield et al., 2002; Norris, 1992). However, scale creation methods have mainly focused on Classical Test Theory (CTT) approaches, such as cumulative sum scores or Cronbach's alpha estimates of reliability. Moreover, CTT assumes that all PTE items are equally weighted and representative of the war trauma trait they intend to measure. A major limitation of CTT is that item parameters are sample-dependent, making it difficult to generalize across similar populations that may vary in trait levels (DeVellis, 2006; Hays et al., 2006). Item Response Theory (IRT) models can be used to address some of these methodological aspects, comprising a set of techniques that estimate measurement precision across levels of the latent trait, based on participant responses and item properties (Hambleton, 2000; Zanon et al., 2016). However, few studies have used IRT for the HTQ, and these studies have only examined the PTSD items, with little item-level analysis of the traumatic events (Choi et al., 2006).

1.4. Sex differences in war trauma

Further, important differences in how men and women experience, cope with, and respond to PTEs, may guide the development and delivery of gender-sensitive trauma-focused interventions. Overall, studies have shown that some traumatic experiences like sexual assault and loss of spouse are reported higher by women whereas other types of experiences like accidents, imprisonment, and forced recruitment are more commonly reported by men (Liebling and Kiziri-Mayengo, 2002; Seedat and Stein, 2000; Seguin et al., 2016; Tolin and Foa, 2006). Limited research from South Sudan has found high levels of sexual and gender-based violence against women, especially mass rape of young women (Amusan and Ufuoma, 2020; Deng et al., 2015; Murphy et al., 2020, 2019; Scott et al., 2013; Tankink, 2013). However, there is a gap in research regarding sex differences in trauma exposure among South Sudanese internally displaced persons. Along with overall sex differences, we can also use IRT to examine whether items function differently for men and women. Differential Item Functioning (DIF) is a set of methods that indicates whether the trauma is experienced similarly across sub-groups, in this case, men and women in South Sudan (Choi et al., 2006; Gerber et al., 2002; Rivollier et al., 2015). If this DIF is severe, we would conclude that the construct of war-related trauma is different between men and women.

1.5. The present study

The present study examines the nature and severity of PTEs experienced by internally displaced men and women in the Malakal Protection of Civilians (PoC) campsite in South Sudan. We assess the psychometric properties of the HTQ using: (a) classical test theory for a descriptive summary of individual PTEs, a trauma sum score, internal consistency reliability, and construct validity; (b) exploratory and confirmatory factor analysis to assess factor structure and unidimensionality; (c) item response theory models to estimate the latent trait-'war trauma'; (d) differential item functioning to assess item equivalence across men and women; and (e) make recommendations for shortened, psychometrically sound versions of the HTQ for this population.

2. Methods

2.1. Sample and procedures

This paper uses cross-sectional survey data from a study conducted by the South Sudan Law Society in a Protection of Civilians (PoC) campsite for internally displaced persons (IDPs) in the Malakal region, Upper Nile State, South Sudan. The full study employed a multi-stage mixed-methods approach, which included a household survey used in our analysis. The researchers used purposive and random sampling techniques to obtain as representative a sample as possible, with participants from different ethnic groups, socioeconomic statuses, and geographic locations (prior to displacement), thereby achieving adequate population coverage. A detailed description of the sampling procedure is provided elsewhere (Deng et al., 2015). Only individuals that were 18 years of age or older and South Sudanese nationals were included in the full study.

Household survey data was collected by 15 enumerators in August 2015 using the KoBoToolbox program for Android-based smartphones. All enumerators were South Sudanese nationals, familiar with the local context, proficient in English, and fluent in languages spoken by the respondents. Enumerators received three days of training on the protection of human subjects, gender and trauma sensitivity, and techniques for administering surveys.

In the interest of security and confidentiality, respondent data was de-identified. All participants provided written or verbal informed consent to participate in the study. A technical research ethics committee was set up in South Sudan to ensure protection of human subjects, review measures, and follow study protocols in consultation with the National Bureau of Statistics. The Harvard TH Chan School of Public Health's Institutional Review Board provided ethical approval for secondary analysis of data for this study.

2.2. Measures

The survey consisted of 11 interdependent question modules that drew extensively on similar studies from South Sudan and other post-

conflict environments (Bratton et al., 2014; Deng, 2013).

2.2.1. Potentially traumatic war events (PTEs)

The study used self-reported responses to a version of the Harvard Trauma Questionnaire (HTQ), previously adapted for use in South Sudan to assess 17 different types of PTEs (Ng et al., 2017). Participants answered 'yes' or 'no' to having experienced each event in their lifetime, for items related to sexual assault, kidnapping, resource loss, and death of family, among others (see Table 1 for the full list of items). A sum score was created for the number of events experienced at least once by respondents, ranging from 0 to 17.

2.2.2. Post-Traumatic stress disorder

The HTQ also contained 16 items measuring post-traumatic stress disorder (PTSD) symptoms, corresponding to the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013). Participants self-reported symptoms on a Likert scale, with options ranging from 1 (not at all affected) to 4 (extremely affected), and we computed a total symptom score to look at PTSD risk.

2.2.3. Biological sex

Biological sex was self-reported as "male" or "female".

2.3. Analytic plan

There was little missing data (<10%) with maximum missingness (1.4%) for the items 'family member raped' and 'tortured', and item response theory assumes responses missing at random which was appropriate for our data given the low percentage of missingness. All analyses were conducted using Stata 14.0 (StataCorp, 2015) and Mplus 7.4 (Muthén and Muthén, 2007).

2.3.1. Descriptive statistics and classical test theory

Descriptive characteristics of the sample include the number of respondents who experienced each PTE, and summary statistics for the PTE sum score, stratified by sex (Table 1). Pairwise correlations between PTEs were conducted (Appendix 1). Classical test theory was used to evaluate item characteristics for these seventeen PTEs, including the Cronbach's alpha estimate of internal consistency reliability. These analyses were also conducted to examine the properties of the reduced 15-item and 12-item scales, based on the results of factor analysis and item response theory (Table 1).

2.3.2. Convergent validity

Given the strong theoretical relation between PTEs and PTSD (Momartin et al., 2003; Rasmussen et al., 2015; Schnurr and Green, 2004; Steel et al., 2009, 1999), convergent validity was tested between the HTQ measures of these two related constructs using Pearson correlation.

2.3.3. Factor analysis and unidimensionality

The key assumptions of IRT are unidimensionality (items on the scale represent a single latent construct), and local independence (items are uncorrelated to each other, conditional on the latent trait). For unidimensionality, we first conducted exploratory factor analyses with oblique rotation, retaining factor loadings > 0.30. Scree plots and eigenvalues were used to determine the number of factors. We then conducted confirmatory factor analysis using Robust Weighted Least Squares (WLSMV) to fit a tetrachoric correlation matrix during factor extraction, since the items were dichotomous. Fit statistics for these

Table 2
Unidimensionality and goodness of fit indices of confirmatory factor analysis models.

Model	N	Chi2(df)	RMSEA	CFI	TLI	WRMR
CFA 17 item	1178	952.26 (119)	0.08	0.72	0.68	2.45
CFA 15 item	1178	6.60.13(90)	0.07	0.79	0.76	2.24
CFA 12 item	1178	360.16(54)	0.07	0.87	0.85	1.96
CFA 2-factor	1178	954.54 (118)	0.08	0.72	0.67	2.45
CFA 17-item Men	588	370.31 (119)	0.06	0.85	0.83	1.57
CFA 17-item Women	590	663.29 (119)	0.09	0.56	0.50	2.12

CFA=Confirmatory Factor Analysis; Chi2=Chi Square Test of Model Fit; df=degrees of freedom; RMSEA=Root Mean Square Error of Approximation; CFI=Comparative Fit Index; TLI=Tucker Lewis Index; WRMR=Weighted Root Mean Square Residual.

Table 1
Descriptive characteristics of the sample.

	N (%)/ Mean (SD)	Item-test correlation	Cronbach's alpha	Men N (%)/ Mean (SD)	Women N (%)/ Mean (SD)	Chi2/ T-test	P value
Potentially Traumatic War Events (PTE)							
Abduction	152 (13%)	0.20		77 (13%)	75 (13%)		
Child's Abduction	104 (9%)	0.27		50 (9%)	54 (9%)		
Disappearance of Family Member	591 (50%)	0.50		282 (48%)	309 (53%)		
Imprisonment	223 (19%)	0.46		147 (25%)	76 (13%)	28.19	<0.001
Forced Recruitment in Combat	116 (10%)	0.36		91 (16%)	35 (4%)	42.03	<0.001
Forced Recruitment in Household	308 (26%)	0.52		187 (32%)	121 (21%)	20.28	<0.001
Exposure to War Fighting	652 (55%)	0.40		343 (59%)	309 (53%)	4.25	0.04
Witnessing Killing of Friend/Family	687 (58%)	0.60		346 (59%)	341 (58%)		
Killing of Close Family Member	907 (77%)	0.49		418 (71%)	489 (83%)	21.79	<0.001
Death Threat	514 (44%)	0.59		284 (49%)	230 (39%)	10.77	0.001
Mutilation or Maiming	191 (16%)	0.37		110 (19%)	81 (14%)	5.26	0.02
Rape	51 (4%)	0.21		5 (1%)	46 (8%)	33.31	<0.001
Family Member's Rape	165 (14%)	0.41		81 (14%)	84 (14%)		
Witnessing Rape	231 (20%)	0.46		114 (19%)	117 (20%)		
Torture	175 (15%)	0.39		104 (18%)	71 (12%)	7.33	0.007
Destruction of Home or Property	988 (84%)	0.29		477 (82%)	511 (87%)	5.45	0.02
Destruction of Other Assets	863 (73%)	0.31		448 (77%)	415 (70%)	5.9	0.02
PTE Sum Score for all 17 items	5.87 (2.8)		0.70	6.06 (3.04)	5.68 (2.52)	2.31	0.02
PTE Sum Score for 15 items	5.01 (2.64)		0.70	5.17 (2.87)	4.85 (2.39)	2.04	0.04
PTE Sum Score for 12 items	4.04 (2.46)		0.70	4.35 (2.75)	3.91 (2.24)	3.11	0.002
Total PTSD Score	2.43 (0.53)		0.83	2.46 (0.53)	2.41 (0.52)	1.72	0.09
Total	1178 (100%)			588 (49.9%)	590 (50.1%)		

Note: Chi2 and T-test values reported only when statistically significant at $p<0.05$. PTE=Potentially traumatic war events; PTSD=Post-traumatic stress disorder.

models were examined using generally accepted indices of model fit: root-mean-square error of approximation (acceptable RMSEA if < 0.08), the comparative fit index (CFI close to 1.00), Tucker Lewis Index (TLI close to 1), Chi square test (Chi2 best if > 0.90), and the weighted root-mean-square residual (WRMR close to 1). All factor analyses were conducted for the full sample, for men and women separately, as well as for reduced-item scales (Table 2). For local independence, we looked at pairwise item correlations between items (Appendix 1) as well as the matrix of residual item covariances after confirmatory factor analysis (Appendix 2).

2.3.4. Item response theory

Item response theory (IRT) models were fit including one parameter (1 PL) and two parameter (2 PL) logistic regression models, with a likelihood ratio test and theoretical considerations confirming the choice of the 2 PL model (Table 3). The 2 PL model has the following specification, where the probability of person j endorsing item i is a function of the item's discrimination (a_i) and location (b_i) parameters, given the latent trait for war trauma (θj):

$$\log\left(\frac{P(Y_{ij}=1)}{1-P(Y_{ij}=1)}\right) = a_i(\theta_j - b_i),\ \theta_j \sim\ N(0,1)$$

The item's discrimination parameter indicates how strongly the item is related to the latent trait, and the location parameter indicates where along the latent trauma trait continuum the item has a 50% probability of being endorsed. Item characteristic curves depicted the probability of experiencing PTEs plotted against latent levels of the trait 'war trauma', with vertical lines drawn for selected items of varying location (Fig. 1). Item information curves show which items provided the most information on the underlying trauma trait (highest curve at latent trait = 0), since higher curves represent more sensitive items, and item location is represented by the curve's relative position on the war trauma trait scale (Fig. 2).

2.3.5. Differential item functioning

To determine whether observed differences between men and women could be explained by non-equivalence of items across these groups, differential item functioning (DIF) analyses were conducted using both, logistic regression models as well as Mantel-Haenszel χ^2 as a sensitivity check for the former. Since both methods yielded similar results, the coefficients/odds ratios from logistic regression DIF models are presented. In the models, responses to each item were regressed on sex, with PTE sum score (without the score of that specific item) as a covariate (Table 4).

Stratified Analyses for Men and Women

Based on theoretical considerations and the results of the DIF findings above, all IRT analyses that were carried out for the full sample were run separately for men and women as well.

3. Results

The total analytic sample of the study consisted of 1178 adults (50% women) aged 18 to 91 years, with a mean age of 39.40 years (SD=13.55). Descriptive statistics for the full sample, men, and women are presented in Table 1.

3.1. Summary of potentially traumatic war events (PTEs)

The most reported PTEs in this sample were destruction of home or property (84%), killing of close family/friend (77%), and other assets being destroyed (73%) (Table 1). The least commonly reported PTEs were rape (4%), abduction of children (9%), and forced recruitment in combat (10%).

Men reported the following PTEs significantly more than women in this sample: imprisonment, forced recruitment in the fighting forces, forced recruitment of a family member, exposure to war fighting, death threat, mutilation or maiming, torture, and destruction of assets. On the other hand, women reported the following PTEs significantly more than men: killing of a close family member, rape, and destruction of home or property. In terms of the PTE sum score, the mean number of PTEs was significantly higher for men than for women.

3.2. Classical test theory (CTT) and internal consistency reliability

The mean proportion of each of the 17 PTE items (presented as percentages) is representative of the 'location' parameter in Classical Test Theory (CTT), such that items with lower means imply less frequently reported and thereby greater location (Table 1). The discrimination parameter from CTT can be estimated from the item-test correlations, such the items with greater item-test correlations are more sensitive in detecting the underlying war trauma trait. The most sensitive item was witnessing the killing of a family or friend, whereas the

Table 3
Coefficients (and Standard Errors) for the full sample and sex-stratified 2PL item response theory models.

	Full sample (N = 1178)				Men (N = 588)		Women (N = 590)	
	17-item model		12-item model		17-item model			
	a	b	a	b	a	b	a	b
Destruction of Home or Property	0.65 (0.11)	−2.82 (0.42)	–	–	0.82 (0.15)	−2.08 (0.33)	0.28 (0.16)	−6.83 (3.74)
Destruction of Other Assets	0.38 (0.08)	−2.76 (0.59)	–	–	0.61 (0.13)	−2.11 (0.42)	0.05 (0.11)	−19.02 (46.32)
Killing of Close Family Member	1.54 (0.15)	−1.11 (0.09)	1.47 (0.15)	−1.14 (0.09)	2.03 (0.26)	−0.73 (0.08)	1.03 (0.18)	−1.83 (0.26)
Exposed to War Fighting	0.65 (0.08)	−0.37 (0.11)	0.66 (0.08)	−0.37 (0.11)	0.73 (0.12)	−0.52 (0.15)	0.50 (0.11)	−0.21 (0.18)
Witnessing Killing of Friend/Family	2.15 (0.21)	−0.26 (0.05)	2.14 (0.22)	−0.26 (0.05)	2.37 (0.31)	−0.26 (0.07)	2.00 (0.30)	−0.25 (0.26)
Disappearance of Family Member	1.11 (0.11)	−0.02 (0.07)	1.06 (0.10)	−0.02 (0.07)	1.43 (0.18)	0.07 (0.08)	0.78 (0.13)	−0.15 (0.12)
Death Threat	1.60 (0.15)	0.23 (0.05)	1.62 (0.15)	0.23 (0.05)	1.65 (0.21)	0.06 (0.07)	1.46 (0.20)	0.42 (0.09)
Forced Recruitment in Household	1.28 (0.13)	1.05 (0.09)	1.30 (0.13)	1.04 (0.09)	1.58 (0.20)	0.68 (0.09)	0.79 (0.15)	1.92 (0.33)
Witnessing Rape	1.36 (0.14)	1.37 (0.11)	1.37 (0.14)	1.36 (0.11)	1.19 (0.18)	1.50 (0.18)	2.07 (0.32)	1.10 (0.11)
Imprisonment	1.18 (0.13)	1.54 (0.14)	1.21 (0.13)	1.51 (0.13)	1.14 (0.16)	1.20 (0.15)	1.08 (0.19)	2.13 (0.30)
Family Member's Rape	1.21 (0.14)	1.85 (0.17)	1.17 (0.14)	1.89 (0.17)	1.04 (0.18)	2.06 (0.29)	1.72 (0.26)	1.51 (0.15)
Torture	0.99 (0.13)	2.04 (0.21)	0.97 (0.13)	2.08 (0.22)	1.02 (0.17)	1.77 (0.25)	0.94 (0.19)	2.41 (0.39)
Mutilation/Maiming	0.85 (0.11)	2.18 (0.25)	0.88 (0.12)	2.13 (0.24)	0.90 (0.16)	1.87 (0.28)	0.68 (0.16)	2.93 (0.63)
Forced Recruitment in Combat	1.11 (0.15)	2.39 (0.25)	1.11 (0.15)	2.40 (0.25)	1.18 (0.19)	1.78 (0.22)	0.71 (0.26)	4.71 (1.54)
Child's kidnapping	0.71 (0.13)	3.58 (0.59)	–	–	0.78 (0.19)	3.34 (0.70)	0.60 (0.18)	4.08 (1.14)
Rape	0.89 (0.19)	3.86 (0.69)	–	–	0.16 (0.52)	30.51 (101.86)	1.87 (0.35)	1.95 (0.21)
Abduction	0.28 (0.11)	6.91 (2.55)	–	–	0.31 (0.14)	6.25 (2.85)	0.35 (0.16)	5.55 (2.39)
AIC	18,191.22		13,910.90		9191.28		8816.76	
BIC	18,363.65		14,032.62		9340.09		8965.69	

a = Discrimination, b = Location, AIC = Akaike Information Criteria, BIC = Bayesian Information Criteria.

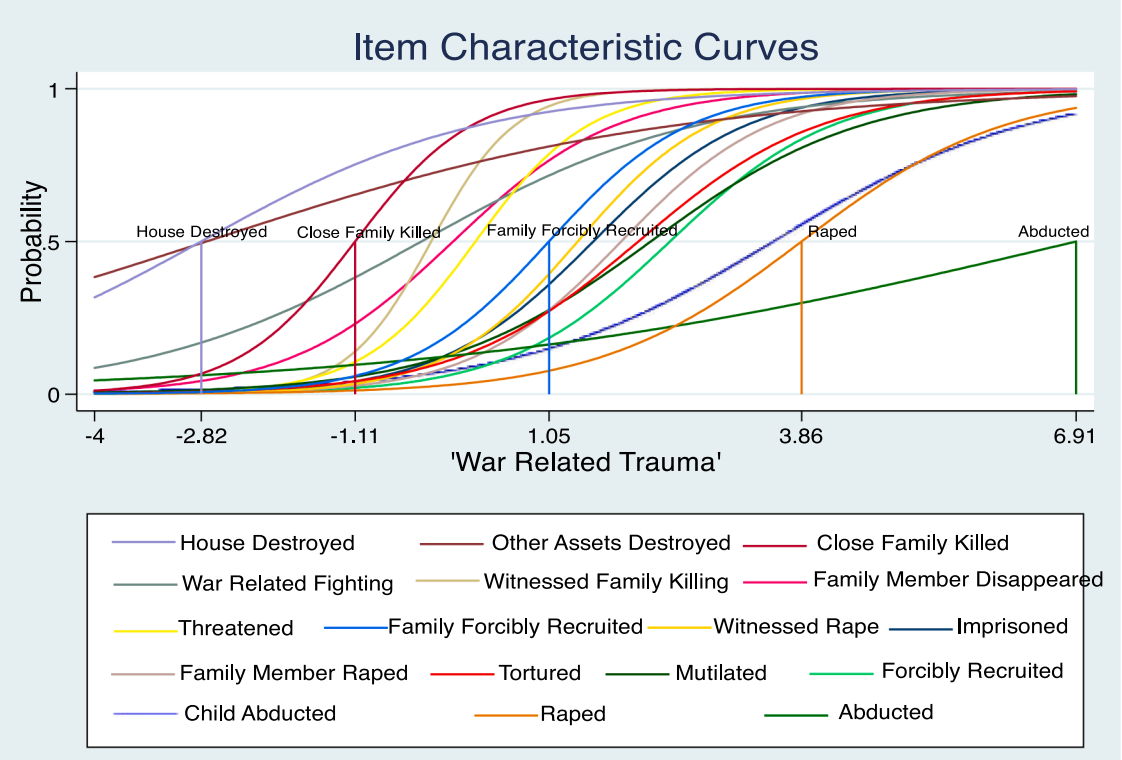


Fig. 1. Item characteristic curves for PTEs from the 2PL IRT model.

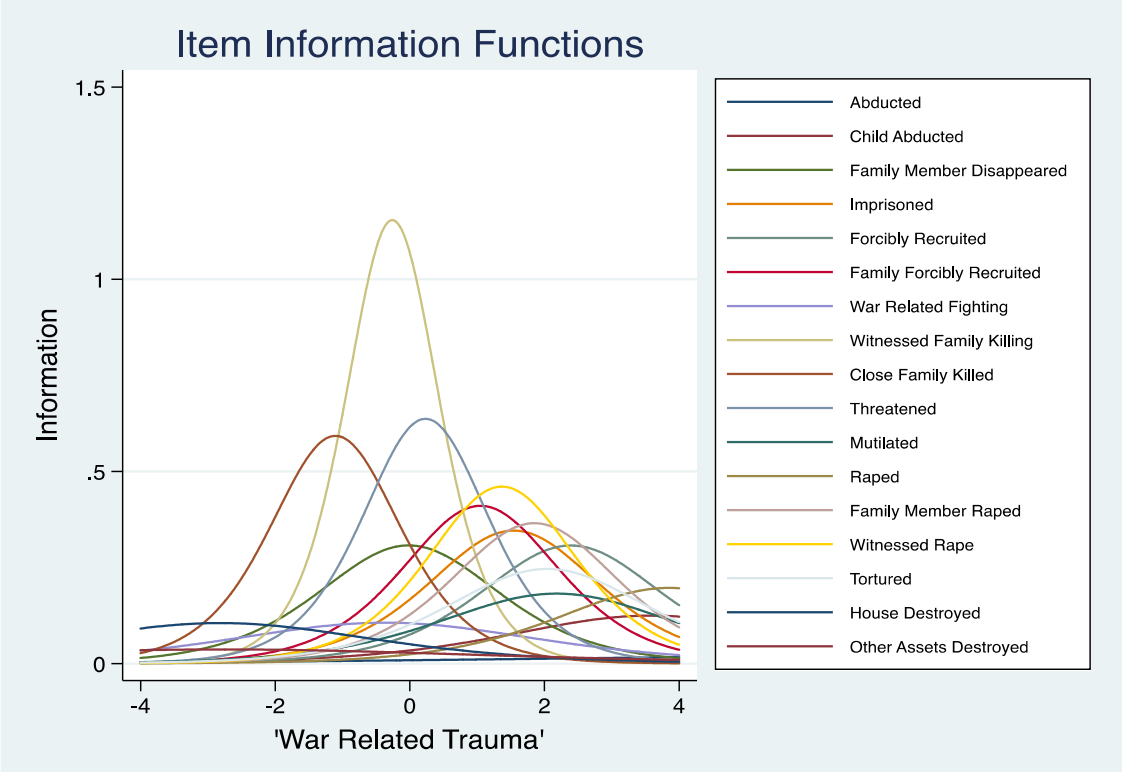
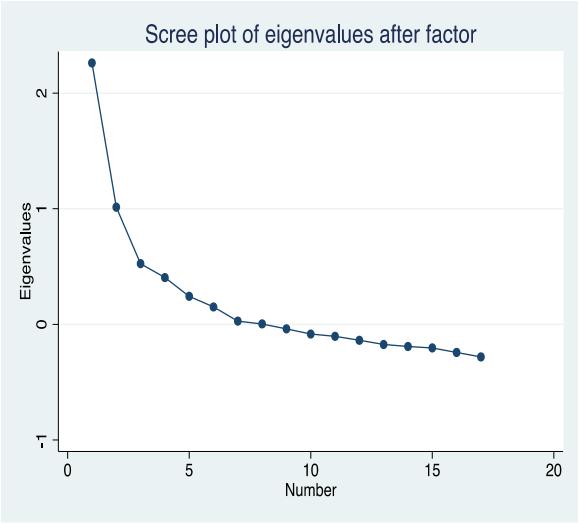


Fig. 2. Item information curves for the 2 PL model.

Table 4
Differential Item functioning logistic regression coefficients for women compared to men.

	$\hat{b}$	Std. Error	p-value
Abduction	0.00	0.18	1.00
Child's kidnapping	0.22	0.21	0.30
Disappearance of Family Member	**0.34**	**0.13**	**0.007**
Imprisonment	**−0.76**	**0.16**	**<0.0001**
Forced Recruitment in Combat	**−1.37**	**0.24**	**<0.0001**
Forced Recruitment in Household	**−0.54**	**0.15**	**<0.0001**
Exposure to War Fighting	−0.20	0.12	0.10
Witnessing Killing of Friend/Family	0.09	0.14	0.49
Killing of Close Family Member	**0.93**	**0.16**	**<0.0001**
Death Threat	**−0.32**	**0.13**	**0.02**
Mutilation/Maiming	−0.26	0.17	0.11
Rape	**2.62**	**0.49**	**<0.0001**
Family Member's Rape	0.24	0.18	0.18
Witnessing Rape	0.25	0.16	0.12
Torture	−0.32	0.17	0.07
Destruction of Home or Property	**0.45**	**0.17**	**0.007**
Destruction of Other Assets	**−0.29**	**0.13**	**0.03**

$\hat{b}$=beta coefficient. *p<0.05, ** p <0.001.



Appendix 3. Exploratory factor analysis scree plot.

least sensitive item was abduction. The PTE items demonstrated acceptable internal consistency with Cronbach's alpha of 0.70. In comparison, the Cronbach's alpha was 0.62 for women and 0.74 for men. Cronbach's alpha for the PTSD items was 0.83, demonstrating good internal consistency reliability.

3.3. War trauma and PTSD risk

Pearson correlation and linear regression results showed a statistically significant association between the 17-item PTE sum score and the total PTSD score (B = 0.027, SE(B)=0.005, p<0.0001), providing correlational evidence for convergent validity of the measure.

3.4. Factor analysis, unidimensionality, and local independence

Exploratory factor analysis (EFA) did not reveal coherent or theoretically supported factor groupings (scree plot in Appendix 3, EFA results available upon request). However, the ratio of the eigenvalues for the first factor compared to the second factor was twice as large, and the percentage variance explained by the first factor was 51%, are considered to be indicative of unidimensionality (Reckase, 1979). Confirmatory factor analysis (CFA) of the one-factor solution was conducted and revealed acceptable goodness-of-fit statistics for RMSEA (RMSEA=0.077, CFI=0.72, TLI=0.68), providing some evidence for unidimensionality.

For local independence, we computed pairwise residual item covariances after CFA and found low residual covariance values (Appendix 2). Moreover, pairwise correlation coefficients between PTEs ranged from −0.16 (between kidnapping and destruction of house/property) to 0.37 (between witnessing killing of family/friend and having a close family/friend killed) (Appendix 1). Most correlations between PTEs were positive but not very high, indicating local independence of items.

For women, CFA of the one-factor solution revealed acceptable goodness-of-fit statistics for RMSEA, but not for CFI/TLI (RMSEA=0.088, CFI=0.56, TLI=0.50). For men, CFA of the one-factor solution revealed better goodness-of-fit statistics (RMSEA=0.06, CFI=0.85, TLI=0.83), and EFA results revealed eigenvalues and scree plots corresponding with a one-factor solution, indicating unidimensionality for men. Full-sample CFA models were also conducted for the 15-item, 12-item, and two-factor structures (Table 2).

3.5. Item response theory (IRT)

The 'location' parameter from the IRT model represents event reporting, such that higher location coefficients imply that respondents were less likely to have experienced that event. The 'discrimination' parameter represents item accuracy in differentiating between varying levels of the latent war trauma trait, with higher discrimination parameters implying better ability to differentiate. The one-parameter (1 PL) logistic regression model (where discrimination is fixed to 1 for all items) showed that the location estimates of items ranged from −1.98 (destruction of home) to 3.49 (rape), in line with the CTT results. The two-parameter (2 PL) logistic regression model (varying discrimination and location estimates for each item) revealed discrimination estimates ranging from 0.28 (abduction) as least sensitive to 2.15 (witnessed killing of family/friend) as most sensitive to the underlying latent trait for war trauma (Table 3).

Location estimates ranged from −2.82 (destruction of home) as most likely to be reported to 6.91 (abduction) as least likely to be reported. A likelihood ratio test was conducted to compare the 1PL and 2PL models and revealed that the 2PL model has better fit ($\chi^2(16)$ = 229.14, p<0.001). Item characteristic curves for the 2 PL model (Fig. 1) with steeper slopes represent items that are more sensitive (such as witnessing the killing of family/friend and torture) compared to more flat curves for items that are less sensitive (abduction or destruction of other assets). Items representing less commonly experienced PTEs have curves to the right side of the graph compared to curves for items on the left side for more commonly experienced PTEs. Item information curves (Fig. 2) revealed that the item 'witnessing family or friend killed' was the most informative item for underlying trauma, followed by 'death threat' and 'killing of close family/friend'. The fit statistics for the IRT model are as follows: Akaike's information criterion (AIC) of 18,191.22 and Bayesian information criterion (BIC) of 18,363.65.

Results from sex-stratified 2 PL IRT models reveal that discrimination estimates for men ranged from 0.16 (rape) as least sensitive to 2.37 (witnessing killing of family/friend) as most sensitive to the war trauma trait. Location estimates ranged from −2.11 (destruction of other assets) as most reported by men to 30.51 (rape) as least commonly reported by men (Table 3). For women, on the other hand, discrimination estimates ranged from 0.05 (destruction of other assets) to 2.00 (witnessing killing

of family/friend), although the items related to rape had extremely high discrimination coefficients too (witnessing rape=2.07, being raped=1.87, family member raped=1.72). Location estimates revealed that women commonly experienced the destruction of assets and property (destruction of other assets =−19.02, destruction of home=−6.83), and least commonly experienced abduction (5.55) and forced recruitment in combat (4.71). The item characteristic curves and item information curves for men and women were very similar to those for the full sample and are thus not presented here.

3.6. Differential item functioning

Differential item functioning (DIF) analyses examined whether men and women reported individual PTEs similarly after adjusting for differences in latent trait levels for war trauma. Conditional on PTE sum score, for men and women with the same overall trauma score, women reported higher disappearance of close family member ($B = 0.34$, SE(B)=0.13, $p<0.01$), killing of close family member ($B = 0.93$, SE(B)=0.16, $p<0.001$), rape ($B = 2.62$, SE(B)=0.49, $p<0.001$), and destruction of home or property ($B = 0.45$, SE(B)=0.17, $p<0.01$) (Table 4). On the other hand, conditional on the sum score, men significantly reported the following experiences more than women: imprisonment ($B=-0.76$, SE(B) =0.16, $p<0.001$), forced recruitment in combat ($B=-1.37$, SE(B)=0.24, $p<0.001$), forced recruitment in the household ($B=-0.54$, SE(B)=0.15, $p<0.001$), death threat ($B=-0.32$, SE(B)=0.13, $p<0.05$), and destruction of other assets ($B=-0.29$ SE(B)=0.13, $p<0.05$).

3.7. Scale reduction

Based on the IRT results above, the least informative items in terms of low discrimination in the 2 PL model, are: abduction and destruction of assets. These two items also represent extremely low and high reporting respectively. When we removed these two items, the Cronbach's alpha for the remaining 15 items remained 0.70 for the full sample, 0.66 for women and 0.74 for men. When we removed three additional items (rape, child's abduction, and destruction of home or property), factor analysis results indicated unidimensionality for this 12-item version, and the Cronbach's alpha for these 12 items was 0.71 for the full sample, 0.65 for women and 0.74 for men. However, given the salience and impact of rape on women, it would not be recommended to remove this item, even though the greatest DIF across men and women was found for this item. Taken together, these findings suggest that rather than removing items completely, there is a need to create two separate trauma scales for men and women, given the salient sex differences in trauma experiences.

4. Discussion

This study provides a comprehensive psychometric analysis of the Harvard Trauma Questionnaire (HTQ), adapted for trauma assessment of internally displaced men and women in conflict-affected South Sudan. We used classical test theory, factor analysis, item response theory, and differential item functioning approaches. Overall, we found good convergent validity and internal consistency reliability for the HTQ war events subscale. Item response theory models revealed that some PTEs (for example, witnessing the killing of family or friends) were more sensitive to the 'war trauma' trait than others (for example, being abducted). Although there were no theoretically relevant factor groupings, and there seemed to be evidence for unidimensionality, differential item functioning analyses revealed that the measure performed differently for men and women, indicating the need for a sex-stratified measure of trauma. Recommendations for items to be used for a revised version of the HTQ in this sample are made, along with suggestions for future research avenues for this topic.

Our study revealed high exposure to potentially traumatic war events (PTEs) in this sample, with most people experiencing between 2 and 9 PTEs, and 90% having experienced at least 10 PTEs in their lifetime, in line with previous research from South Sudan (Deng et al., 2015; Ng et al., 2017; Roberts et al., 2009b). On average, men said yes to having experienced more PTEs than women, which is in line with previous studies from refugees and internally displaced persons from conflict-affected regions showing greater number of traumatic events experienced by men (Breslau, 2002; Norris, 1992; Tolin and Foa, 2006). However, it should be noted that this does not imply greater severity of trauma or cumulative trauma history among men, which should be also be assessed in future research.

Classical test theory (CTT) is commonly used to create a sum score to assess war trauma, and also provide evidence for internal consistency (Cronbach's alpha) of survey instruments (Hambleton and Jones, 1993; Hays et al., 2006; Krynen et al., 2013). This study provides evidence of acceptable internal consistency, with higher Cronbach's alpha among men ($\alpha = 0.74$), which is in line with previous research with the entire HTQ (Hollifield et al., 2005; Mollica et al., 1992). Another study from South Sudan showed Cronbach alpha estimates of 0.75 and 0.76 (men and women during the war) and 0.86 and 0.84 (men and women after the Peace Agreement) (Ayazi et al., 2013).

While sum scores are helpful in understanding the number of traumatic stressors, they assume that the quantity of PTEs experienced is what matters, hypothesizing a linear relationship between the number of events and degree of underlying trauma. Rather, studies have found qualitative differences in how people experience and respond to various stressors, as well as how specific PTEs contribute uniquely to psychopathology, which a sum score index may mask (Amstadter and Vernon, 2008; Arnetz et al., 2014).

The most commonly reported PTEs in our study were destruction of home and other assets, which may be explained by the specific study context where the sample comprises internally displaced persons who had to leave their homes and are living in a protection of civilians campsite due to the war-related violence and destruction. Women reported having experienced rape, property loss, and killing of family member significantly more than men, which is supported by previous findings (Liebling and Kiziri-Mayengo, 2002; Morina and Emmelkamp, 2012; Seguin et al., 2016; Tolin and Foa, 2006). However, it is possible that men were less likely to self-report sexual assault experiences due to the social stigma and perceived gender norms. Men reported combat, imprisonment, and war injuries more than women, in line with other studies (Somasundaram and Sivayokan, 1994; Tolin and Foa, 2006).

Upon examining the factor structure of the HTQ, while several groupings of PTEs could be made, none were strongly supported by theoretical frameworks. Together, the results of the exploratory and confirmatory factor analyses provided some evidence for unidimensionality, especially in men and for the 12-item measure. However, it should be noted that in mental health research, multiple subdomains of latent traits can be present even when the construct is unidimensional (Betancourt et al., 2014). Moreover, the CFA approach to unidimensionality is more rooted in reflective models of measurement, where an underlying trait for trauma is said to cause traumatic experiences. Rather, for checklists like the HTQ, formative models of internal validity may be more applicable where people have adverse experiences that cause the latent trauma trait, and more measurement research on this topic is needed (Bethell et al., 2017; Edwards, 2011).

Having established internal consistency, construct validity, and

unidimensionality of the measure using widely accepted statistics, we conducted further item and trait-level analyses using item response theory (IRT) models. These models allow for greater score precision by weighting the location and discrimination parameters of the items. This results in person-free and item-free estimates of the latent war trauma trait, allowing for greater generalizability than CTT methods. The two-parameter logistic IRT model revealed how some items (including abduction, destruction of home and other assets, exposure to fighting, and kidnapping) do not provide adequate information to distinguish between levels of war trauma in this sample. Sex-stratified IRT models found that while rape was an important item to include for women, for men it was not sensitive and rarely reported. Across models, witnessing killings of close friends or family was most sensitive item (highest discrimination score) for the latent trauma trait.

The results from the differential item functioning (DIF) analysis suggests measurement invariance across items for men and women. Similar to other studies, war-related trauma was much higher for women experiencing rape, loss of a loved one, or resource loss (Morina and Emmelkamp, 2012; Seguin et al., 2016; Tolin and Foa, 2006), and higher for men experiencing combat and detention related traumas (Somasundaram and Sivayokan, 1994). These results emphasize the importance of studying trauma and its manifestation separately in men and women, including the need to develop and validate a sex-specific version of the Harvard Trauma Questionnaire.

4.1. Limitations

Although the sampling procedures were designed to achieve good population coverage, it was not possible to obtain a truly random sample due to the ongoing war. Therefore, the sample may not be representative of the broader population in South Sudan, and caution should be exercised while generalizing the results of this study to other populations in South Sudan and beyond. Second, the use of self-report questions may lead to recall and response bias, especially for war events that may be too traumatic to accurately remember and report. However, the study team also conducted follow-up questions about the timing and frequency of war events, along with qualitative interview data about these experiences, which were meant to sensitively elicit and triangulate the results of the survey. Third, it should be noted that latent trait models are not completely reflective for tools like the HTQ, and that further research on formative measurement models is needed. And finally, the HTQ items for PTEs were selected and refined for this study based on pretesting, stakeholder workshops, and previous studies with South Sudanese populations (Ayazi et al., 2012, 2013; Roberts et al., 2009). Therefore, although the measure was culturally adapted, it may not represent the entire universe of PTEs that people in conflict-affected zones may experience. Moreover, although this study did not assess the respondents' trauma history (timing of past traumas, duration, severity) and subsequent daily hardships, future studies should include these variables.

4.2. Strengths and future directions

Despite these limitations, this study applied robust methods to comprehensively understand war-related trauma in South Sudan, a historically under researched region. The fairly large sample size (especially for such a mobile population) also allowed for stratified analyses by sex, offering a nuanced understanding of gender-based traumatization. Future research should test whether these results hold across populations sampled from other regions of the country, so that recommendations for removing or amending items for adapted versions of the HTQ can be made in a culturally sensitive way. Given the urgency and scarcity of basic services in humanitarian contexts, emphasizing brevity of survey measures becomes critical, and IRT and DIF can aid the selection of items that provide the maximum information about the mental health of specific population groups (Haroz et al., 2020). Moreover, to evaluate the clustering of traumatic events that tend to occur together and the profiles of people experiencing certain traumas, future research may utilize network analysis and latent class analysis approaches.

5. Conclusion

The HTQ is one of the most commonly used instrument to measure trauma with war-affected populations (Hollifield et al., 2002; Sigvardsdotter et al., 2016a), however its use should be accompanied by adequate cultural adaptation and psychometric evaluation. The present study highlights the need for the development and validation of a sex-specific version of the HTQ, to capture the unique trauma experiences of men and women in conflict zones. Moreover, there needs to be greater emphasis on measurement research in global health, including appropriate conceptual frameworks, especially in low-resource humanitarian settings where the findings from studies employing survey measures are used for priority setting in the delivery of financial and psychosocial aid.

CRediT authorship contribution statement

Manasi Sharma: Conceptualization, Visualization, Formal analysis, Data curation, Writing – original draft. **Karestan C Koenen:** Writing – review & editing. **Christina P C Borba:** Writing – review & editing. **David R Williams:** Writing – review & editing. **David K Deng:** Project administration, Conceptualization, Visualization.

Conflict of Interest

The authors declare that they have no competing interests.

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Appendix

Appendix 1

Pairwise correlations between PTE items.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Kidnapped or Abducted	1.00																
2	Child Abducted	0.20	1.00															
3	Family Member Disappeared	0.03	0.14	1.00														
4	Ever Imprisoned	0.07	0.05	0.09	1.00													
5	Forcibly Recruited in Combat	0.07	0.14	0.16	0.23	1.00												
6	Forced Recruitment in Household	−0.01	0.10	0.20	0.29	0.29	1.00											
7	Exposed to War-Related Fighting	−0.11	−0.06	0.09	0.20	0.06	0.14	1.00										
8	Witnessed Killing of Friend/Family	0.04	0.11	0.36	0.15	0.11	0.19	0.18	1.00									
9	Close Family Member Killed	−0.09	0.07	0.34	0.11	0.10	0.17	0.12	0.37	1.00								
10	Threatened with Death	0.12	0.09	0.12	0.24	0.11	0.21	0.20	0.37	0.20	1.00							
11	Mutilated/Maimed/Injured	0.13	0.07	0.12	0.15	0.17	0.20	0.02	0.10	0.07	0.23	1.00						
12	Raped	0.23	0.07	0.03	0.02	−0.01	−0.04	0.05	0.11	0.00	0.13	0.07	1.00					
13	Family Member Raped	0.07	0.08	0.10	0.15	0.07	0.18	0.13	0.18	0.09	0.19	0.09	0.24	1.00				
14	Witnessed Rape	0.09	0.05	0.14	0.18	0.10	0.20	0.09	0.28	0.08	0.28	0.11	0.28	0.33	1.00			
15	Tortured	0.10	0.07	0.05	0.16	0.06	0.15	0.13	0.15	0.12	0.27	0.18	0.13	0.08	0.11	1.00		
16	Home or Property Destroyed	−0.16	0.02	0.14	0.04	0.01	0.10	0.15	0.14	0.33	0.02	−0.06	−0.16	0.01	−0.01	0.06	1.00	
17	Other Assets Destroyed	0.00	0.06	0.13	0.07	0.07	0.14	0.11	0.06	0.10	0.11	0.01	−0.13	0.03	−0.06	0.03	0.24	1.00

Appendix 2

Matrix of item covariance residuals after confirmatory factor analysis.

		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
1	Kidnapped or Abducted	0																
2	Child Abducted	0.018	0															
3	Family Member Disappeared	−0.003	0.009	0														
4	Ever Imprisoned	0.004	−0.004	−0.016	0													
5	Forcibly Recruited in Combat	0.002	0.006	0.005	0.012	0												
6	Forced Recruitment in Household	−0.009	0.002	0.000	0.019	0.021	0											
7	Exposed to War-Related Fighting	−0.025	−0.018	−0.007	0.015	−0.002	0.001	0										
8	Witnessed Killing of Friend/Family	−0.006	−0.001	0.028	−0.015	−0.011	−0.018	0.002	0									
9	Close Family Member Killed	−0.022	−0.002	0.034	−0.008	−0.004	−0.005	−0.001	0.026	0								
10	Threatened with Death	0.008	−0.002	−0.025	0.004	−0.008	−0.009	0.006	0.009	−0.008	0							
11	Mutilated/Maimed/Injured	0.013	0.002	−0.001	0.004	0.009	0.010	−0.014	−0.014	−0.009	0.010	0						
12	Raped	0.014	0.002	−0.006	−0.005	−0.006	−0.012	0.000	0.000	−0.007	0.002	0.001	0					
13	Family Member Raped	0.003	0.002	−0.010	0.000	−0.003	0.001	0.001	−0.006	−0.009	−0.002	−0.003	0.013	0				
14	Witnessed Rape	0.005	−0.006	−0.009	−0.001	−0.005	0.001	−0.007	0.004	−0.017	0.006	−0.001	0.017	0.023	0			
15	Tortured	0.008	0.001	−0.015	0.004	−0.005	−0.001	0.007	−0.008	−0.004	0.016	0.010	0.005	−0.005	−0.003	0		
16	Home or Property Destroyed	−0.021	−0.002	0.012	−0.006	−0.003	0.004	0.014	0.008	0.038	−0.013	−0.015	−0.014	−0.008	−0.014	−0.001	0	
17	Other Assets Destroyed	−0.002	0.004	0.013	0.000	0.004	0.012	0.013	−0.005	0.006	0.006	−0.008	−0.014	−0.006	−0.024	−0.003	0.032	0

References

American Psychiatric Association, 2013. Diagnostic and Statistical Manual of Mental Disorders (DSM-5®). American Psychiatric Pub.

Amstadter, A.B., Vernon, L.L., 2008. Emotional reactions during and after trauma: a comparison of trauma types. J. Aggress. Maltreat. Trauma 16, 391–408. https://doi.org/10.1080/10926770801926492.

Amusan, L., Ufuoma, E.P., 2020. Psychological Effect of Civil Strife on Women and Girls in South Sudan. Psychology and Education 57, 382–387.

Arnetz, B.B., Broadbridge, C.L., Jamil, H., Lumley, M.A., Pole, N., Barkho, E., Fakhouri, M., Talia, Y.R., Arnetz, J.E., 2014. Specific trauma subtypes improve the predictive validity of the Harvard Trauma Questionnaire in Iraqi refugees. J. Immigr. Minor. Health 16, 1055–1061. https://doi.org/10.1007/s10903-014-9995-9.

Attanayake, V., McKay, R., Joffres, M., Singh, S., Jr, F.B., Mills, E., 2009. Prevalence of mental disorders among children exposed to war: a systematic review of 7920 children. Med. Confl. Surviv. 25, 4–19. https://doi.org/10.1080/13623690802568913.

Ayazi, T., Lien, L., Eide, A.H., Jenkins, R., Albino, R.A., Hauff, E., 2013. Disability associated with exposure to traumatic events: results from a cross-sectional community survey in South Sudan. BMC Public Health 13, 469. https://doi.org/10.1186/1471-2458-13-469.

Ayazi, T., Lien, L., Eide, A.H., Ruom, M.M., Hauff, E., 2012. What are the risk factors for the comorbidity of posttraumatic stress disorder and depression in a war-affected population? A cross-sectional community study in South Sudan. BMC Psychiatry 12, 1.

Betancourt, T.S., Yang, F., Bolton, P., Normand, S.L., 2014. Developing an African youth psychosocial assessment: an application of item response theory: using IRT to refine an assessment for African youth. Int. J. Methods Psychiatr. Res. 23, 142–160. https://doi.org/10.1002/mpr.1420.

Bethell, C.D., Carle, A., Hudziak, J., Gombojav, N., Powers, K., Wade, R., Braveman, P., 2017. Methods to assess adverse childhood experiences of children and families: toward approaches to promote child well-being in policy and practice. Acad. Pediatr. 17, S51–S69.

Bratton, M., Coulibaly, M., Dulani, B., 2014. Malians want a united country, post-conflict justice. Afrobarometer Policy Pap 13.

Breslau, N., 2002. Gender differences in trauma and posttraumatic stress disorder. J. Gend. Specif. Med. JGSM 5, 34–40. Off. J. Partnersh. Womens Health Columbia.

Charlson, F., van Ommeren, M., Flaxman, A., Cornett, J., Whiteford, H., Saxena, S., 2019. New WHO prevalence estimates of mental disorders in conflict settings: a systematic review and meta-analysis. Lancet 394, 240–248. https://doi.org/10.1016/S0140-6736(19)30934-1.

Choi, Y., Mericle, A., Harachi, T.W., 2006. Using rasch analysis to test the cross-cultural item equivalence of the Harvard Trauma Questionnaire and the hopkins symptom checklist across Vietnamese and Cambodian immigrant mothers. J. Appl. Meas. 7, 16–38.

Deng, D., 2013. Challenges of accountability: an assessment of dispute resolution processes in Rural South Sudan. South Sudan Law Society (SSLS), South Sudan. http://www.pactworld.org/library/challenges-accountability-assessment-dispute-resolution-processes-rural-south-sudan (accessed 2.10.18).

Deng, D., Pritchard, M., Sharma, M., 2015. A War Within: Perceptions of Truth, Justice, Reconciliation and Healing in the Malakal PoC. United States Agency for International Development, Washington, D.C.

DeVellis, R.F., 2006. Classical test theory. Med. Care 44, S50–S59.

Edwards, J.R., 2011. The fallacy of formative measurement. Organ. Res. Methods 14, 370–388. https://doi.org/10.1177/1094428110378369.

Fawzi, M.C., Pham, T., Lin, L., Nguyen, T.V., Ngo, D., Murphy, E., Mollica, R.F., 1997. The validity of posttraumatic stress disorder among Vietnamese refugees. J. Trauma. Stress 10, 101–108. https://doi.org/10.1023/a:1024812514796.

Gerber, B., Smith, E.V., Girotti, M., Pelaez, L., Lawless, K., Smolin, L., Brodsky, I., Eiser, A., 2002. Using Rasch measurement to investigate the cross-form equivalence and clinical utility of Spanish and English versions of a diabetes questionnaire: a pilot study. J. Appl. Meas. 3, 243–271.

Hambleton, R.K., 2000. Emergence of item response modeling in instrument development and data analysis. Med. Care 38, II60–II65.

Hambleton, R.K., Jones, R.W., 1993. Comparison of classical test theory and item response theory and their applications to test development. Educ. Meas. Issues Pract. 12, 38–47. https://doi.org/10.1111/j.1745-3992.1993.tb00543.x.

Haroz, E.E., Kane, J.C., Nguyen, A.J., Bass, J.K., Murray, L.K., Bolton, P., 2020. When less is more: reducing redundancy in mental health and psychosocial instruments using item response theory. Glob. Ment. Health 7. https://doi.org/10.1017/gmh.2019.30.

Hays, R.D., Brown, J., Brown, L.U., Spritzer, K.L., Crall, J.J., 2006. Classical test theory and item response theory analyses of multi-item scales assessing parents' perceptions of their children's dental care. Med. Care 1, S60–S68.

Hollifield, M., Eckert, V., Warner, T.D., Jenkins, J., Krakow, B., Ruiz, J., Westermeyer, J., 2005. Development of an inventory for measuring war-related events in refugees. Compr. Psychiatry 46, 67–80. https://doi.org/10.1016/j.comppsych.2004.07.003.

Hollifield, M., Warner, T.D., Lian, N., Krakow, B., Jenkins, J.H., Kesler, J., Stevenson, J., Westermeyer, J., 2002. Measuring trauma and health status in refugees: a critical review. JAMA 288, 611–621.

Johnson, H., Thompson, A., 2008. The development and maintenance of post-traumatic stress disorder (PTSD) in civilian adult survivors of war trauma and torture: a review. Clin. Psychol. Rev. 28, 36–47. https://doi.org/10.1016/j.cpr.2007.01.017.

Karunakara, U.K., Neuner, F., Schauer, M., Singh, K., Hill, K., Elbert, T., Burnham, G., 2004. Traumatic events and symptoms of post-traumatic stress disorder amongst Sudanese nationals, refugees and Ugandans in the West Nile. Afr. Health Sci. 4, 83–93.

Krynen, A., Osborne, D., Duck, I.M., Houkamau, C., Sibley, C.G., 2013. Measuring psychological distress in New Zealand: item response properties and demographic differences in the Kessler-6 screening measure. NZ J. Psychol. 42, 69–83.

Liebling, H., Kiziri-Mayengo, R., 2002. The psychological effects of gender-based violence following armed conflict in Luwero District, Uganda. Fem. Psychol. 12, 553–560. https://doi.org/10.1177/0959353502012004015.

Mollica, R.F., Caspi-Yavin, Y., Bollini, P., Truong, T., Tor, S., Lavelle, J., 1992. The Harvard Trauma Questionnaire. Validating a cross-cultural instrument for measuring torture, trauma, and posttraumatic stress disorder in Indochinese refugees. J. Nerv. Ment. Dis. 180, 111–116.

Mollica, R.F., Caspi-Yavin, Y., Lavelle, J., Tor, S., Yang, T., Chan, S., Pham, T., Ryan, A., de Marneffe, D., 1996. Harvard Trauma Questionnaire (HTQ): manual Cambodian, Laotian and Vietnamese versions. Harvard Program in Refugee Trauma, Boston.

Mollica, R.F., Wyshak, G., Lavelle, J., 1987. The psychosocial impact of war trauma and torture on Southeast Asian refugees. Am. J. Psychiatry 144, 1567–1572. https://doi.org/10.1176/ajp.144.12.1567.

Momartin, S., Silove, D., Manicavasagar, V., Steel, Z., 2003. Dimensions of trauma associated with posttraumatic stress disorder (PTSD) caseness, severity and functional impairment: a study of Bosnian refugees resettled in Australia. Soc. Sci. Med. 57, 775–781.

Morina, N., Emmelkamp, P.M.G., 2012. Mental health outcomes of widowed and married mothers after war. Br. J. Psychiatry J. Ment. Sci. 200, 158–159. https://doi.org/10.1192/bjp.bp.111.093609.

Murphy, M., Bingenheimer, J.B., Ovince, J., Ellsberg, M., Contreras-Urbina, M., 2019. The effects of conflict and displacement on violence against adolescent girls in South Sudan: the case of adolescent girls in the protection of civilian sites in Juba. Sex. Reprod. Health Matters 27, 181–191. https://doi.org/10.1080/26410397.2019.1601965.

Murphy, M., Ellsberg, M., Contreras-Urbina, M., 2020. Nowhere to go: disclosure and help-seeking behaviors for survivors of violence against women and girls in South Sudan. Confl. Health 14, 6. https://doi.org/10.1186/s13031-020-0257-2.

Murthy, R.S., 2007. Mass violence and mental health-recent epidemiological findings. Int. Rev. Psychiatry 19, 183–192. https://doi.org/10.1080/09540260701365460. Abingdon Engl.

Muthén, L.K., Muthén, B.O., 2007. Mplus User's Guide, 6th ed. Muthén & Muthén, Los Angeles, CA.

Neuner, F., Schauer, M., Karunakara, U., Klaschik, C., Robert, C., Elbert, T., 2004. Psychological trauma and evidence for enhanced vulnerability for posttraumatic stress disorder through previous trauma among West Nile refugees. BMC Psychiatry 4, 34. https://doi.org/10.1186/1471-244X-4-34.

Ng, L.C., López, B., Pritchard, M., Deng, D., 2017. Posttraumatic stress disorder, trauma, and reconciliation in South Sudan. Soc. Psychiatry Psychiatr. Epidemiol. 52, 705–714. https://doi.org/10.1007/s00127-017-1376-y.

Norris, F.H., 1992. Epidemiology of trauma: frequency and impact of different potentially traumatic events on different demographic groups. J. Consult. Clin. Psychol. 60, 409–418.

Pritchard, M.F., Deng, D.K., Sharma, M., 2019. Trauma and inter-communal relations among a captive population: preliminary findings from the malakal protection of civilians site, South Sudan. In: Campbell, G., Stanziani, A. (Eds.), The Palgrave Handbook of Bondage and Human Rights in Africa and Asia. Palgrave Macmillan US, New York, pp. 327–345. https://doi.org/10.1057/978-1-349-95957-0_16.

Rasmussen, A., Smith, H., Keller, A.S., 2007. Factor structure of PTSD symptoms among West and Central African refugees. J. Trauma. Stress 20, 271–280. https://doi.org/10.1002/jts.20208.

Rasmussen, A., Verkuilen, J., Ho, E., Fan, Y., 2015. Posttraumatic stress disorder among refugees: measurement invariance of Harvard Trauma Questionnaire scores across global regions and response patterns. Psychol. Assess. 27, 1160–1170. https://doi.org/10.1037/pas0000115.

Reckase, M.D., 1979. Unifactor latent trait models applied to multifactor tests: results and implications. J. Educ. Stat. 4, 207–230. https://doi.org/10.3102/10769986004003207.

Rivollier, F., Peyre, H., Hoertel, N., Blanco, C., Limosin, F., Delorme, R., 2015. Sex differences in DSM-IV posttraumatic stress disorder symptoms expression using item response theory: a population-based study. J. Affect. Disord. 187, 211–217. https://doi.org/10.1016/j.jad.2015.07.047.

Roberts, B., Damundu, E.Y., Lomoro, O., Sondorp, E., 2009a. Post-conflict mental health needs: a cross-sectional survey of trauma, depression and associated factors in Juba, Southern Sudan. BMC Psychiatry 9, 7. https://doi.org/10.1186/1471-244X-9-7.

Roberts, B., Damundu, E.Y., Lomoro, O., Sondorp, E., 2009b. Post-conflict mental health needs: a cross-sectional survey of trauma, depression and associated factors in Juba, Southern Sudan. BMC Psychiatry 9. https://doi.org/10.1186/1471-244X-9-7.

Schnurr, P.P., Green, B.L., 2004. Understanding relationships among trauma, post-tramatic stress disorder, and health outcomes. Adv. Mind Body Med. 20, 18–29.

Scott, J., Averbach, S., Modest, A.M., Hacker, M.R., Cornish, S., Spencer, D., Murphy, M., Parmar, P., 2013. An assessment of gender inequitable norms and gender-based violence in South Sudan: a community-based participatory research approach. Confl. Health 7, 4. https://doi.org/10.1186/1752-1505-7-4.

Seedat, S., Stein, D.J., 2000. Trauma and post-traumatic stress disorder in women: a review. Int. Clin. Psychopharmacol. 15 (Suppl 3), S25–S33.

Seguin, M., Lewis, R., Amirejibi, T., Razmadze, M., Makhashvili, N., Roberts, B., 2016. Our flesh is here but our soul stayed there: a qualitative study on resource loss due to war and displacement among internally-displaced women in the Republic of Georgia. Soc. Sci. Med. 150, 239–247. https://doi.org/10.1016/j.socscimed.2015.12.045, 1982.

Sigvardsdotter, E., Malm, A., Tinghög, P., Vaez, M., Saboonchi, F., 2016a. Refugee trauma measurement: a review of existing checklists. Public Health Rev. 37 https://doi.org/10.1186/s40985-016-0024-5.

Sigvardsdotter, E., Malm, A., Tinghög, P., Vaez, M., Saboonchi, F., 2016b. Refugee trauma measurement: a review of existing checklists. Public Health Rev. 37, 10. https://doi.org/10.1186/s40985-016-0024-5.

Somasundaram, D.J., Sivayokan, S., 1994. War trauma in a civilian population. Br. J. Psychiatry J. Ment. Sci. 165, 524–527.

StataCorp, 2015. Stata Statistical Software: Release 14. StataCorp LP, College Station.

Steel, Z., Chey, T., Silove, D., Marnane, C., Bryant, R.A., van Ommeren, M., 2009. Association of torture and other potentially traumatic events with mental health outcomes among populations exposed to mass conflict and displacement: a systematic review and meta-analysis. JAMA 302, 537–549. https://doi.org/10.1001/jama.2009.1132.

Steel, Z., Silove, D., Bird, K., McGorry, P., Mohan, P., 1999. Pathways from war trauma to posttraumatic stress symptoms among Tamil asylum seekers, refugees, and immigrants. J. Trauma. Stress 12, 421–435. https://doi.org/10.1023/A:1024710902534.

Tankink, M.T.A., 2013. The silence of South-Sudanese women: social risks in talking about experiences of sexual violence. Cult. Health Sex. 15, 391–403. https://doi.org/10.1080/13691058.2012.752936.

Tay, A.K., Jayasuriya, R., Jayasuriya, D., Silove, D., 2017. Assessing the factorial structure and measurement invariance of PTSD by gender and ethnic groups in Sri Lanka: an analysis of the modified Harvard Trauma Questionnaire (HTQ). J. Anxiety Disord. 47, 45–53. https://doi.org/10.1016/j.janxdis.2017.02.001.

Tolin, D.F., Foa, E.B., 2006. Sex differences in trauma and posttraumatic stress disorder: a quantitative review of 25 years of research. Psychol. Bull. 132, 959–992. https://doi.org/10.1037/0033-2909.132.6.959.

Tutlam, N.T., Flick, L.H., Xian, H., Matsuo, H., Glowinski, A., Tutdeal, N., 2020. Trauma-associated psychiatric disorders among South Sudanese dinka and nuer women resettled in the USA. Glob. Soc. Welf. 7, 189–199. https://doi.org/10.1007/s40609-020-00171-7.

Zanon, C., Hutz, C.S., Yoo, H., Hambleton, R.K., 2016. An application of item response theory to psychological test development. Psicol. Reflex. E Crít. 29, 18. https://doi.org/10.1186/s41155-016-0040-x.