EUROPEAN JOURNAL OF PSYCHOTRAUMATOLOGY
2021, VOL. 12, 1930702
https://doi.org/10.1080/20008198.2021.1930702

EUROPEAN JOURNAL OF PSYCHO-TRAUMATOLOGY
THE OFFICIAL JOURNAL OF THE EUROPEAN SOCIETY FOR TRAUMATIC STRESS STUDIES

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BASIC RESEARCH ARTICLE

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# Sex differences in PTSD risk: evidence from post-conflict populations challenges the general assumption of increased vulnerability in females

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## ABSTRACT

**Background**: Next to the dose-dependent effect of trauma load, female sex represents a well-established risk factor for PTSD. Exposure to particularly toxic traumatic event types, different coping styles, and biological risk factors are frequently listed as potential causes for the increased PTSD vulnerability in females. Nevertheless, sex differences have not been consistently observed in all study populations.

**Objective**: To investigate sex differences in PTSD risk in post-conflict populations from different countries while considering trauma load.

**Method**: In civilian post-conflict samples from Northern Uganda ($N = 1665$), Rwanda ($N = 433$), Syria ($N = 974$) and Sri Lanka ($N = 165$), we investigated sex differences in PTSD risk while taking trauma load into account. PTSD and trauma load were assessed using standardized diagnostic interviews. Potential sex differences in PTSD risk were analysed by logistic regression analyses considering trauma load.

**Results**: Across all samples, males reported more traumatic events than females. Both sexes predominantly reported war-related traumatic events. Without considering trauma load, sex effects in PTSD risk were only detected in the Syrian sample. When taking trauma load into account, evidence for an increased PTSD vulnerability in females was found in the Syrian sample, and, to a much lesser extent, in the Northern Ugandan sample.

**Conclusion**: In contrast to the literature, we did not find evidence for a general increased PTSD vulnerability in females. The dose-response effect of trauma load was a much stronger predictor of PTSD risk than sex across all samples.

## ARTICLE HISTORY

Received 6 October 2020
Revised 16 February 2021
Accepted 7 May 2021

## KEYWORDS

Posttraumatic stress disorder; prevalence; sex differences; trauma load; conflict; war

## PALABRAS CLAVE

Trastorno de estrés postraumático; prevalencia; diferencias según sexo; carga traumática; conflicto; guerra

## 关键词

创伤后应激障碍; 患病率; 性别差异; 创伤负荷; 冲突; 战争

## HIGHLIGHTS

- In four samples of civilian conflict survivors, sex did not influence PTSD risk as strongly as commonly reported in the literature.
- If males and females experience similar trauma event types and a high amount of traumatic stress, sex differences in PTSD risk seem to decrease.

## Diferencias según sexo para el riesgo de desarrollar el TEPT: La evidencia en poblaciones post-conflicto desafía la hipótesis general de un incremento de la vulnerabilidad en mujeres

**Antecedentes**: Junto al efecto dosis-dependiente de la carga traumática, el sexo femenino representa un factor de riesgo bien establecido para el desarrollo del trastorno de estrés postraumático (TEPT). La exposición a tipos de eventos particularmente tóxicos, diferentes estilos de afrontamiento y factores de riesgo biológicos se enumeran con frecuencia como causas potenciales del aumento de la vulnerabilidad al TEPT en las mujeres. Sin embargo, no se ha observado de manera consistente la diferencia según sexo en todas las poblaciones estudiadas.

**Objetivo**: Investigar las diferencias según sexo para el desarrollo del TEPT en poblaciones post-conflicto de diferentes países teniendo en consideración la carga traumática.

**Métodos**: Se investigaron diferencias en el TEPT según sexo tomando en consideración la carga traumática a partir de muestras post-conflicto de población civil en el norte de Uganda ($N = 1665$), Ruanda ($N = 433$), Siria ($N = 947$) y Sri Lanka ($N = 165$). El TEPT y la carga traumática se evaluaron empleando entrevistas diagnósticas. Se analizaron las potenciales diferencias según sexo para el riesgo de desarrollar el TEPT empleando un análisis de regresión logística y considerando la carga traumática.

**Resultados**: En todas las muestras, los varones reportaron mayor número de eventos traumáticos que las mujeres. Ambos sexos reportaron predominantemente eventos traumáticos relacionados a la guerra. Dejando de lado la carga traumática, los efectos del sexo para el riesgo de desarrollar el TEPT solo se encontraron en la muestra siria. Cuando se toma en consideración la carga traumática, se encontró un incremento en la vulnerabilidad

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Supplemental data for this article can be accessed here.

para el desarrollo del TEPT en mujeres dentro de la muestra siria y, en menor medida, en la del norte de Uganda.
**Conclusión**: En contraste con la literatura, no se encontró evidencia de un incremento generalizado de la vulnerabilidad para el desarrollo del TEPT en mujeres. El efecto dosis-respuesta de la carga traumática fue un predictor mucho más fuerte para el riesgo del desarrollo del TEPT que el sexo en todas las muestras.

**PTSD风险的性别差异:来自冲突后人群的证据挑战了女性易感性增加的一般假设**

**背景**: 除了创伤负荷的剂量依赖性效应之外，女性代表了一个确定的PTSD风险因素。暴露于特别有毒的创伤事件类型，不同的应对方式以及生物学风险因素经常被列为女性PTSD易感性增加的潜在原因。然而，并非在所有研究人群中都一致观察到了性别差异。
**目的**: 在考虑创伤负荷的同时，考查来自不同国家的冲突后人群在PTSD风险中的性别差异。
**方法**: 在来自乌干达北部 (*N* = 1665)，卢旺达 (*N* = 433)，叙利亚 (*N* = 974) 和斯里兰卡 (*N* = 165) 的冲突后平民样本中，我们在将创伤负荷考虑在内的同时，考查了PTSD风险的性别差异。PTSD和创伤负荷使用标准化诊断访谈进行评估。PTSD风险中潜在的性别差异通过考虑创伤负荷的逻辑回归分析进行分析。
**结果**: 在所有样本中，男性报告了比女性更多的创伤事件。两性都主要报告战争相关的创伤事件。在不考虑创伤负荷的情况下，仅在叙利亚样本中检测到了PTSD风险的性别效应。考虑到创伤负荷，在叙利亚样本中发现了女性PTSD易感性增加的证据，而在乌干达北部样本中则发现了降低的证据。
**结论**: 与文献相反，我们没有发现女性PTSD易感性普遍升高的证据。在所有样本中，创伤负荷的剂量反应效应是一个比性别更强的PTSD风险预测因素。

## 1. Introduction

Female sex constitutes a well-established risk factor for PTSD (Breslau, Davis, Andreski, Peterson, & Schultz, 1997). Representative surveys investigating civil populations of industrialized countries such as the USA (Kessler, 1995), Canada (van Ameringen, Mancini, Patterson, & Boyle, 2008), and Germany (Perkonigg, Kessler, Storz, & Wittchen, 2000) indicate that the PTSD prevalence in females is approximately twice as high as in males. Similarly, in a meta-analysis summarizing the results of 40 publications, the odds to develop PTSD were twice as high in females as opposed to males (Tolin & Foa, 2006). Notably, the higher prevalence of PTSD in females was observed despite a higher occurrence of traumatic event exposure in males (Gavranidou & Rosner, 2003; Tolin & Foa, 2006). Furthermore, the sex difference remained significant irrespective of methodological differences of the studies included in the meta-analysis (e.g. diagnostic interview vs. self-report, adult vs. child/adolescent sample, epidemiological vs convenience sample) (Tolin & Foa, 2006).

Several reasons might account for the observed sex differences in PTSD vulnerability (Gavranidou & Rosner, 2003, for reviews, see e.g. Olff, 2017; Olff, Langeland, Draijer, & Gersons, 2007). Despite the fact that males generally have a higher probability to encounter at least one traumatic event in their lifetime, females are more likely to experience certain man-made traumata known to have a particularly high impact on PTSD development, such as sexual abuse (Breslau et al., 1997; Kessler, 1995; Tolin & Foa, 2006). However, males are more likely to experience combat, war, and terrorism (Tolin & Foa, 2006), events that are also associated with high conditional PTSD risk (Kessler, 1995). Furthermore, females more often experience traumatic events at a younger age than males (Olff et al., 2007), and this is associated with windows of greater neurodevelopmental vulnerability (Andersen & Teicher, 2008). From a biological perspective, a greater HPA axis sensitivity, the influence of sex hormones and neurosteroids on emotional learning and memory formation as well as differences in brain anatomy and activation in response to traumatic stress might contribute to the higher PTSD vulnerability in females (Kornfield, Hantsoo, & Epperson, 2018). Furthermore, higher inflammation in females during pregnancy and postpartum (Christian & Porter, 2014) might increase PTSD vulnerability, since low-grade inflammation has been hypothesized as a PTSD risk factor (Sumner, Nishimi, Koenen, Roberts, & Kubzansky, 2020). In addition, females tend to use emotional and ruminative coping styles more often than males (Christiansen, Hansen, & Elklit, 2014; Gavranidou & Rosner, 2003; Johnson & Whisman, 2013; Morano, 2010; Olff et al., 2007), which might render them more vulnerable to PTSD. Furthermore, peritraumatic dissociative reactions, yet another PTSD risk factor, are more prevalent in females (Christiansen & Hansen, 2015).

Nevertheless, sex differences have not been consistently observed in all studies. For example, several studies investigating military samples did not observe

any sex differences in PTSD rates (Hourani, Williams, Bray, Wilk, & Hoge, 2016; Jacobson, Donoho, Crum-Cianflone, & Maguen, 2015; Woodhead, Wessely, Jones, Fear, & Hatch, 2012). Likewise, after adjusting for demographic variables and lifetime trauma exposure, Bowler et al. (2017) observed no sex differences in PTSD symptom severity in World Trade Center survivors. Therefore, one might assume that the differences between PTSD rates in females and males are less pronounced if they are exposed to similar types and a similar dose of traumatic stressors.

In this line, it is important to acknowledge the dose-response effect of trauma load when investigating individual differences in PTSD risk. In survivors of conflict, it has been repeatedly shown that with an accumulating number of different traumatic event types experienced, the likelihood to develop PTSD increases in a dose-dependent manner (Catani, Jacob, Schauer, Kohila, & Neuner, 2008; Kolassa et al., 2010; Mollica, McInnes, Pool, & Tor, 1998; Neuner et al., 2004; Wilker et al., 2015). Therefore, it is important to include trauma load in studies aiming at investigating sex differences in PTSD risk. However, while the majority of the studies analysed in the meta-analysis by Tolin and Foa (2006) reported different prevalence rates in traumatic event exposure between females and males, only six of the 40 publications included in the meta-analysis accounted simultaneously for the influence of the dose-dependent effect of trauma load and sex on PTSD risk. Those studies identified a strong dose-dependent effect of trauma load on PTSD risk, which tended to be more pronounced in females as opposed to males (Cuffe et al., 1998; Fitzpatrick & Boldizar, 1993; Lloyd & Turner, 2003; Norris et al., 2003; Perkonigg et al., 2000; Stein, Walker, & Forde, 2000). Several recent studies also found the sex effect on PTSD risk to be amplified when including trauma history (Axinn, Ghimire, Williams, & Scott, 2013; Cloitre et al., 2019) while others failed to find a sex effect when accounting for trauma load (Bowler et al., 2017; Briere, Agee, & Dietrich, 2016). Furthermore, investigations which analysed the dose-dependent effect on PTSD symptom severity found that relative to their level of trauma exposure, females seem to report more pronounced PTSD symptoms than males (Ahern et al., 2004; Ainamani, Elbert, Olema, & Hecker, 2020; Domanskaité-Gota, Elklit, & Christiansen, 2009).

Another puzzle concerning the observed sex differences in PTSD risk is that the magnitude of these differences was found to vary across cultures (Norris, Perilla, Ibañez, & Murphy, 2001; Valentine et al., 2019). In this line, it was argued that at least some of the differences observed in the prevalence of PTSD might be due to the traditional roles and expectations of women and men, which vary by culture (Gavranidou & Rosner, 2003). For example, men might tend to overreport the dangerous situations they have survived and underreport mental health symptoms, as it could be interpreted as a weakness within the societal context. In contrast, women who live in societies fostering traditional gender roles might be more willing to talk about fear and vulnerability (Gavranidou & Rosner, 2003). It is important to consider that women who live in societies fostering traditional gender roles often suffer from adverse life circumstances such as economic inequality as well as unequal access to education and health care, which limit their resources to cope with the traumatic experiences encountered, which could also reinforce gender differences in PTSD vulnerability (Gavranidou & Rosner, 2003). This hypothesis was supported by a transcultural study by Norris and colleagues (Norris et al., 2001) that reported higher sex differences in PTSD risk in cultures fostering traditional gender roles. However, it has to be noted that sex differences in PTSD risk have been also observed in Scandinavian countries (e.g. Lassemo, Sandanger, Nygård, & Sørgaard, 2017), which are known to be very progressive in terms of gender equality.

In the present study, we aim at investigating sex differences in PTSD risk in large civilian samples from different post-conflict populations. These samples are specifically suited to investigate sex differences in PTSD risk as male and female civilian survivors were exposed to the same conflict and hence faced – in addition to general traumatic events – similar war-related events. Furthermore, there is a high variability in the amount of different traumatic event types experienced, allowing us to include the dose-dependent effect of trauma load in the analyses and to model potential sex × trauma load interaction effects. We included four samples from different countries: survivors of the war between a rebel group and the governmental forces in Northern Uganda ($N$ = 1665), survivors of the Rwandan genocide ($N$ = 443), Syrian refugees ($N$ = 974), and conflict survivors from Sri Lanka ($N$ = 165). In all samples, the number of lifetime traumatic events has been systematically investigated, allowing us to investigate sex differences in PTSD risk, by taking differences in trauma exposure into account.

## 2. Methods and materials

### 2.1. Samples

#### 2.1.1. Northern Ugandan sample

Survivors of the war between the rebel group Lord's Resistance Army (LRA) and the Ugandan governmental forces, which mainly took place between 1987 and 2007, participated in the study. Study participants were exposed to war and combat as well as to atrocities committed by the LRA, including abductions, forced

recruitment as child soldiers, torture, mutilations and sexual violence. Data was collected in former internally displaced (IDP) camps (Koch Goma and Anaka in Nwoya District, and Pabbo in Amuru District) as well as in villages and communities of Gulu District. The recruitment and data collection has been described in detail elsewhere (Schneider et al., 2018; Wilker et al., 2018). Inclusion criteria were a minimum age of 18 years, no signs of alcohol or substance abuse, no severe acute psychotic symptoms, and no current intake of psychotropic medication. A total number of 1813 individuals provided written informed consent and participated in the diagnostic interview. We excluded individuals who showed signs of current alcohol abuse and with missing or erroneous data points, resulting in a final sample of $N$ = 1665 individuals ($N$ = 766 males and $N$ = 899 females).

#### 2.1.2. Rwandan sample

Rwandans who had fled to the refugee settlement Nakivale located in Uganda due to the 1994 genocide participated in the study. The recruitment and data collection took place in 2006–2007 and has been described in detail elsewhere (e.g. Kolassa et al., 2010). Inclusion criteria were a minimum age of 18 years, no signs of alcohol or substance abuse, and no severe acute psychotic symptoms. A total number of 514 individuals provided written informed consent and participated in the diagnostic interview. We excluded individuals without trauma exposure and with missing or erroneous data points, leading to a sample of $N$ = 443 individuals included in the analyses ($N$ = 237 males and $N$ = 206 females).

#### 2.1.3. Sri Lankan sample

The sample was recruited in 2011 as part of an epidemiological study conducted in the Jaffna district in the north of Sri Lanka, investigating the consequences of the 2004 tsunami and conflict on family dynamics. The Jaffna region was affected by the long-lasting civil war in Sri Lanka, which lasted more than 25 years and ended in 2009. Families were recruited via schools in three different areas within the Jaffna region and they gave written informed consent prior to study participation. For more details regarding the data collection, the reader is referred to Sriskandarajah, Neuner, and Catani (2015). For the purpose of evaluating sex differences in PTSD risk in adults, we investigated only the parents of the aforementioned families ($N$ = 210; 122 mothers and 88 fathers) in the present paper. Individuals who did not report any traumatic experience and with missing data points for the PTSD diagnosis or traumatic event exposure were excluded, leading to a final sample of $N$ = 165 (92 females and 73 males).

#### 2.1.4. Syrian sample

The participants consisted of Syrian refugees who have been displaced from North and East Syria to the Kurdistan Region of Iraq (KRI) as a consequence of the brutality of the Syrian conflict that started in 2011 as a part of the Arab Spring uprisings, and escalated into an ongoing and multi-sided civil war between Bashar-al-Assad's regime, opposition rebel groups and Syrian democratic forces and their international allies. A total sample of $N$ = 984 Syrian refugees provided informed consent prior to interview participation. Data were collected between December 2016 and July 2017 in Arbat camps in the Sulaymaniyah governorate of the Kurdistan region of Iraq. A detailed description of the data collection procedure is described in detail elsewhere (e.g. Ibrahim, Catani, Ismail, & Neuner, 2019; Ibrahim, Ertl, Catani, Ismail, & Neuner, 2018a). Participants with no trauma exposure history and who were under the age of 18 were excluded from analyses, leading to a sample of $N$ = 974 participants included in the analyses (N = 494 males and $N$ = 480 females).

### 2.2. Study procedure

#### 2.2.1. Northern Ugandan sample

The study procedures were reviewed and approved by the Institutional Review Board of Gulu University, Uganda, the Lacor Hospital Institutional Research Ethics Committee (LHIREC), Gulu, Uganda, the Ugandan National Council for Science and Technology, and the ethics committee of the German Psychological Society (Deutsche Gesellschaft für Psychologie, DGPs). Diagnostic interviews were conducted by trained lay counsellors after an intensive training covering interviewing techniques, the concepts and clinical diagnosis of trauma and PTSD, and quantitative data collection methods. Lifetime traumatic event type exposure was assessed with a checklist of 62 different traumatic events, including general traumatic experiences like natural disasters or accidents, domestic and sexual violence, general war-related events, and specific atrocities frequently committed by the LRA. This check-list has been employed and validated in previous studies (Schneider et al., 2018; Wilker et al., 2015). The lifetime and current diagnosis of PTSD according to DSM-IV was assessed by the Posttraumatic Diagnostic Scale (PDS; Foa, Cashman, Jaycox, & Perry, 1997) employed as a structured diagnostic interview.

#### 2.2.2. Rwandan sample

The Ethics Committee of the University of Konstanz, Germany, and the University of Mbarara, Uganda, approved the study procedures. Similar to the data collection in Northern Uganda, interviews were

conducted by intensely trained local counsellors who employed translated Kinyarwanda versions of the study instruments. In order to assess lifetime trauma exposure, a 36-item event check-list was employed (cf. Kolassa, Kolassa, Ertl, Papassotiropoulos, & De Quervain, 2010). In order to assess current and lifetime PTSD according to DSM-IV, the PDS (Foa et al., 1997) was employed as a structured diagnostic interview.

#### 2.2.3. Sri Lankan sample

The Ethical Review Board of the DGPs and the local school authorities in northern Sri Lanka reviewed and approved the study procedures. The diagnostic interviews were conducted by a group of former local schoolteachers who had been intensively trained as 'Master Counselors' and had a long experience in working with traumatized populations and conducting diagnostic interviews according to scientific standards. In order to assess current PTSD according to DSM-IV, the PDS (Foa et al., 1997) was employed as a structured interview. To evaluate the number of traumatic events experienced, the Life Events Checklist (Gray, Litz, Hsu, & Lombardo, 2004) was extended by items assessing war exposure and family violence, resulting in a final check list of 32 potential traumatic events.

#### 2.2.4. Syrian sample

The study was approved by the Ethical Review Committees of Bielefeld University in Germany and Koya University in the KRI. Using standardized, valid, and reliable trauma and mental health assessment tools, locally trained clinical psychologists and social workers, who had extensive work experience with traumatized people, conducted a structured interview with Syrian participants in the Arbat camp in the KRI. Adverse and traumatic life events were evaluated by applying the War and Adversity Exposure Checklist (Ibrahim et al., 2018a) comprising 25 potential traumatic events. Current PTSD symptoms were assessed by valid and reliable Arabic and Kurdish versions of the PTSD Checklist for DSM-5 (PCL-5) (Ibrahim et al., 2019). To determine probable PTSD diagnosis, the cut-off score of 23 or higher of the PCL-5 was used as suggested in a recent validation study in the same cultural context (Ibrahim, Ertl, Catani, Ismail, & Neuner, 2018b).

For all samples, the diagnostic instruments were translated into the local languages, followed by independent back translations and group discussions to assure the accuracy of the translations.

### 2.3. Statistical procedures

All statistical analyses were conducted in the statistical environment R version 4.0.2 (R Core Team, 2020). Demographic and clinical variables were compared between male and female participants using Fisher's exact tests for categorical data and *t*-tests for continuous variables, with Odds Ratios (ORs) and Cohen's *d* as corresponding effect sizes with 95% confidence intervals.

In order to investigate sex differences in PTSD prevalence in the samples while considering different levels of trauma exposure, we calculated logistic regression analyses including the variables trauma load and sex as well as their interaction. For comparability of parameter estimates across samples, and to allow analyses across samples, traumatic load was standardized within each sample to a mean of 0 and a standard deviation of 1 for the regression analyses. We initially calculated a regression model across all samples, with a three-way- interaction of the factor country (with the four levels Northern Uganda, Rwanda, Syria and Sri Lanka) with trauma load and sex. Statistical significance testing was performed using likelihood ratio (LR) tests. This global analysis was followed up by separate models per country, which included main effects of trauma load and sex as well as their interaction. Confidence intervals shown and reported are central 95% CIs. CIs for fitted probabilities for PTSD are derived from bootstrapping models and calculated fits with 1,000 bootstrap resamples.

## 3. Results

For the demographic and clinical information of the four samples investigated, please see Table 1. In all samples, males reported a significantly higher number of traumatic events than females. However, the distributions of trauma load strongly overlapped between males and females (see Figure S1), allowing a meaningful investigation of potential sex × trauma load interaction effects in logistic regression analyses. Without considering trauma load, there were no sex differences in PTSD prevalence and PTSD symptom severity in the Northern Ugandan, Rwandan, and Sri Lankan sample (Table 1). Yet, in the Syrian sample, the PTSD prevalence, the overall symptom severity, and the PTSD symptom scores of intrusions, alterations of mood and cognition and hyperarousal were higher in females as opposed to males (Table 1). A closer examination of the traumatic events experienced by male and female participants revealed that the most common traumatic experiences were war-related, and prevalence rates for these events were high for both females and males whereas males had slightly elevated prevalence rates (Figures S2–S5). The prevalence of sexual violence was generally higher in females than in males, except for the Sri Lankan sample (Table 1).

**Table 1.** Demographic and clinical information for male and female participants of the four samples investigated.

| Sample | Northern Uganda | | | Rwanda | | | Syria | | | Sri Lanka | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Males ($N$ = 766) | Females ($N$ = 899) | Statistic[1] | Males ($N$ = 237) | Females ($N$ = 206) | Statistic[1] | Males ($N$ = 494) | Females ($N$ = 480) | Statistic[1] | Males ($N$ = 73) | Females ($N$ = 92) | Statistic[1] |
| Mean age [SD] | 32.36 [10.53] | 32.33 [10.9] | $p$ = .95 $d$ = 0 [−0.1; 0.09] | 35.64 [6.07] | 33.8 [5.29] | $p$ = .0008 $d$ = −0.32 [−0.51; −0.13] | 37.19 [10.95] | 32.24 [10.21] | $p$ < .0001 $d$ = 0.47 [0.34; 0.6] | 40.38 [6.37] | 37.64 [5.72] | $p$ = .004 $d$ = −0.46 [−0.77; −0.14] |
| Mean lifetime traumatic load [SD] | 28.91 [9.25] | 26.76 [9.92] | $p$ < .0001 $d$ = −0.22 [−0.32;-0.13] | 13.57 [4.6] | 11.55 [5.08] | $p$ < .0001 $d$ = −0.42 [−0.61; −0.23] | 7.08 [3.77] | 5.67 [3.03] | $p$ < .0001 $d$ = 0.41 [0.28; 0.54] | 12.58 [5.62] | 9.53 [5.11] | $p$ = .0003 $d$ = −0.57 [−0.89; −0.25] |
| $N$ individuals who reported rape/sexual assault[2] (%) | 35 (4.62) | 300 (33.41) | $p$ < .0001 $OR$ = .10 [.06; 0.14] | 1 (0.43) | 29 (14.15) | $p$ < .0001 $OR$ = .03 [0.00; .16] | 2 (0.40) | 5 (1.04) | $p$ = .28 $OR$ = 2.59 [.44; 27.23] | 10 (13.70) | 13 (14.13) | $p$ = 1 $OR$ = 1.04 [.39; 2.8] |
| $N$ Lifetime PTSD (%) | 546 (71.28) | 617 (68.63) | $p$ = .26 $OR$ = 1.13 [.91; 1.41] | 196 (82.70) | 163 (79.13) | $p$ = .40 $OR$ = 1.26 [.76; 2.08] | n.a. | n.a. | n.a. | n.a | n.a | n.a. |
| $N$ Current PTSD (%) | 218 (28.46) | 259 (28.81) | $p$ = .91 $OR$ = .98 [.79; 1.22] | 116 (48.95) | 104 (50.49) | $p$ = .82 $OR$ = .94 [.64; 1.39] | 261 (52.83) | 299 (62.29) | $p$ = .003 $OR$ = 1.48 [1.13; 1.92] | 31 (42.47) | 30 (32.61) | $p$ = .19 $OR$ = 1.52 [.76; 3.03] |
| Mean PDS score [SD] | 5.92 [7.23] | 6.05 [7.31] | $p$ = .71 $d$ = 0.02 [−0.08; 0.11] | 14.23 [9.79] | 15.67 [11.32] | $p$ = .15 $d$ = 0.14 [−0.05; 0.32] | n.a. | n.a. | n.a. | 11.21 [9.48] | 12.57 [11.18] | $p$ = .42 $d$ = 0.13 [−0.19; 0.45] |
| Mean PDS score intrusions [SD] | 1.68 [2.22] | 1.80 [2.31] | $p$ = .27 $d$ = 0.05 [−0.04; 0.15] | 4.55 [3.54] | 5.22 [4.01] | $p$ = .06 $d$ = 0.18 [−0.01; 0.37] | n.a. | n.a. | n.a. | 3.40 [2.8] | 4.28 [4.06] | $p$ = .12 $d$ = 0.25 [−0.07; 0.56] |
| Mean PDS score avoidance [SD] | 2.14 [2.82] | 2.07 [2.74] | $p$ = .62 $d$ = −0.02 [−0.12; 0.07] | 5.44 [4.33] | 5.92 [5.02] | $p$ = .28 $d$ = 0.1 [−0.08; 0.29] | n.a. | n.a. | n.a. | 3.99 [3.89] | 4.51 [4.31] | $p$ = .43 $d$ = 0.13 [−0.19; 0.44] |
| Mean PDS score hyperarousal [SD] | 2.1 [2.74] | 2.18 [2.78] | $p$ = .56 $d$ = 0.03 [−0.07–0.13] | 4.24 [3.27] | 4.53 [3.47] | $p$ = .37 $d$ = 0.09 [−0.1; 0.27] | n.a. | n.a. | n.a. | 3.77 [3.40] | 3.77 [3.77] | $p$ = .99 $d$ = 0 [−0.31; 0.32] |
| Mean PCL-5 score [SD] | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 25.71 [16.34] | 28.06 [13.98] | $p$ = .02 $d$ = −0.15 [−0.28; −0.03] | n.a. | n.a. | n.a. |
| Mean PCL-5 score intrusions [SD] | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 8.24 [5.22] | 9.4 [5.07] | $p$ = .0004 $d$ = −0.22 [−0.35; −0.1] | n.a. | n.a. | n.a. |
| Mean PCL-5 score avoidance [SD] | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 3.82 [2.89] | 2.67 [2.40] | $p$ < .0001 $d$ = 0.43 [0.3; 0.56] | n.a. | n.a. | n.a. |
| Mean PCL-5 score negative alterations of mood and cognition [SD] | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 8.42 [6.08] | 9.52 [5.82] | $p$ = .004 $d$ = −0.19 [−0.31; −0.06] | n.a. | n.a. | n.a. |
| Mean PCL-5 score hyperarousal [SD] | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 5.26 [4.92] | 6.43 [4.78] | $p$ = .0002 $d$ = −0.24 [−0.37; −0.11] | n.a. | n.a. | n.a. |

Abbreviations: $d$, Cohen's $d$; $OR$, Odds Ratio; PTSD, Posttraumatic Stress Disorder; PDS, Posttraumatic Diagnostic Scale; PCL-5, PTSD Checklist for DSM-5.
Note that the PDS was used to assess PTSD diagnosis and symptoms severity in the Northern Ugandan, Rwandan and Sri Lankan sample, while the PCL-5 was employed in the Syrian sample.
[1]$p$-values are reported from Fisher's exact test for categorial data and t-test for continuous data. Odds ratios are reported with 95% confidence intervals.
[2]In the Northern Ugandan and Rwandan sample, rape was assessed in the event list, while sexual assault was assessed in the Syrian and Sri Lanka sample.

**Table 2.** Standardized parameter estimates and standard errors of measurements derived from logistic regression anlayses with the outcome current PTSD conducted separately per sample.

| | Intercept | Traumatic Load | Sex male | Traumatic Load: Sex male |
|---|---|---|---|---|
| Northern Uganda | $\hat{\beta} = -1.12$ | $\hat{\beta} = 1.58$ | $\hat{\beta} = -.37$ | $\hat{\beta} = -.02$ |
| | $se_{\hat{\beta}} = .10$ | $se_{\hat{\beta}} = .12$ | $se_{\hat{\beta}} = .15$ | $se_{\hat{\beta}} = .18$ |
| | $p < .0001$ | $p < .0001$ | $p = .01$ | $p = .92$ |
| Rwanda | $\hat{\beta} = .17$ | $\hat{\beta} = .66$ | $\hat{\beta} = -.35$ | $\hat{\beta} = .01$ |
| | $se_{\hat{\beta}} = .15$ | $se_{\hat{\beta}} = .15$ | $se_{\hat{\beta}} = .21$ | $se_{\hat{\beta}} = .22$ |
| | $p = .26$ | $p < .0001$ | $p = .09$ | $p = .97$ |
| Sri Lanka | $\hat{\beta} = -.63$ | $\hat{\beta} = 1.35$ | $\hat{\beta} = -.05$ | $\hat{\beta} = -.32$ |
| | $se_{\hat{\beta}} = .25$ | $se_{\hat{\beta}} = .33$ | $se_{\hat{\beta}} = .39$ | $se_{\hat{\beta}} = .46$ |
| | $p = .01$ | $p < .0001$ | $p = .89$ | $p = .48$ |
| Syria | $\hat{\beta} = .79$ | $\hat{\beta} = .95$ | $\hat{\beta} = -.75$ | $\hat{\beta} = -.55$ |
| | $se_{\hat{\beta}} = .11$ | $se_{\hat{\beta}} = .14$ | $se_{\hat{\beta}} = .15$ | $se_{\hat{\beta}} = .17$ |
| | $p < .0001$ | $p < .0001$ | $p < .0001$ | $p = .0009$ |

In a logistic regression model including all samples, there was a trend for an interaction of country × trauma load × sex, $\chi^2_3 = 6.53$, $p = .09$ for current PTSD. Lifetime PTSD was only assessed in the Northern Ugandan and Rwandan sample, with no evidence for an interaction of country × trauma load × sex, $\chi^2_1 = .63$, $p = .43$ for lifetime PTSD. Including age as a covariate in these analyses did not alter the results.

For interpretability, these global analyses were followed by separate logistic regression analyses per country that included main effects of trauma load and sex as well as their potential interaction. The results are reported in Table 2 and illustrated in Figure 1 for the outcome *current PTSD*. These analyses revealed large effects of trauma load on current PTSD risk for males and females in all investigated samples. Further, we observed no sex effects on current PTSD risk in the Rwandan and Sri Lankan sample, a small main effect of sex in the Northern Ugandan sample, and a main effect of sex as well as a sex × trauma load interaction effect in the Syrian sample (see Figure 2 for the fitted probabilities per sample as a function of trauma load and sex).

Regarding the outcome *lifetime PTSD*, separate logistic regression analyses per country revealed strong main effects of trauma load, but neither a significant main effect of sex nor a sex × trauma load interaction effect (see Figures 3, S6 and Table S1).

## 4. Discussion

This study investigated sex differences in PTSD risk in four samples of survivors of conflict from different cultures, by taking trauma load into account. We did not find evidence that the PTSD rate was twice as high in females as opposed to males in any of our investigated samples, which is in contrast to a large meta-analysis (Tolin & Foa, 2006) as well as a recent cross-country comparison (Dückers & Olff, 2017). To be precise, without considering trauma load, an elevated PTSD prevalence rate and increased PTSD symptoms in females were only found for current PTSD in the Syrian sample, while no sex differences were observed in the Northern Ugandan, Rwandan, and Sri Lankan sample. However, even in the Syrian sample, the PTSD prevalence in females (62%) was not as different from males (52%) as commonly described in the literature.

In line with the literature, however, we found consistent evidence for an increased prevalence of traumatic events in male as opposed to female participants in all four investigated samples. Since females and males differed in the amount of trauma exposure, it is important to take trauma load into account when investigating sex differences in PTSD risk.

In global models investigating the likelihood of the outcomes current and lifetime PTSD, we found no evidence for a three-way-interaction of the factor country with trauma load and sex, indicating similar dose-response relationships between trauma load and

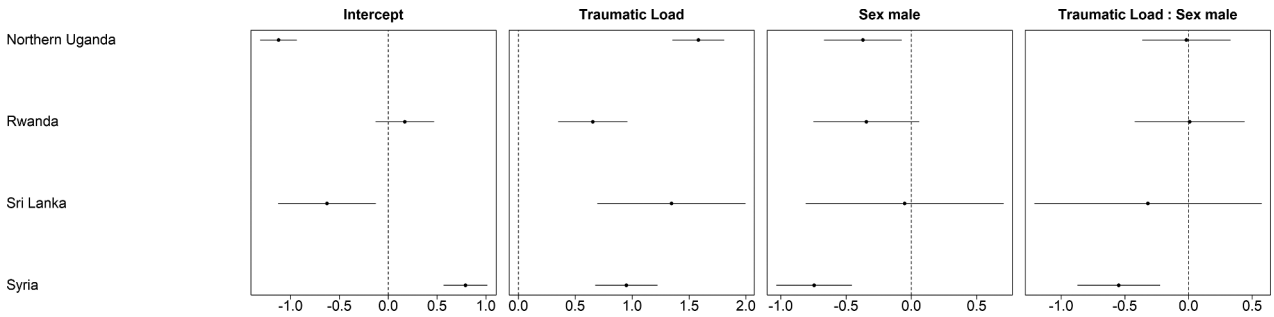


**Figure 1.** Standardized parameter estimates and 95% CIs for current PTSD derived from logistic regression analyses with the outcome current PTSD conducted separately per sample.

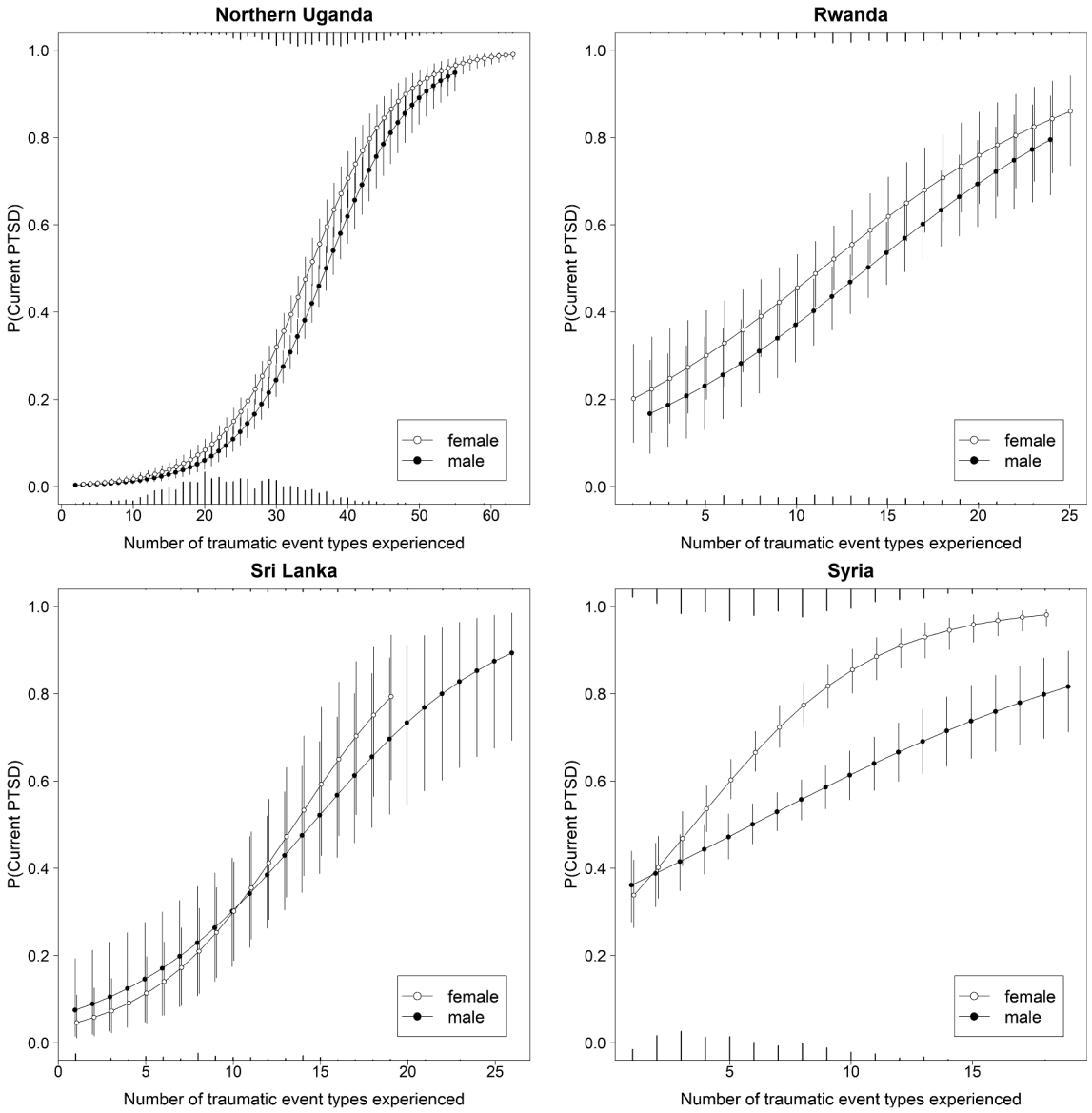


**Figure 2.** Fitted probabilities for current PTSD as functions of trauma load and sex as well as their interaction, with bootstrapped pointwise CIs. Rug plots show histograms of lifetime traumatic load for current PTSD patients (top of panels) and participants without current PTSD (bottom), and are to a common vertical scale.

PTSD risk for females and males across all samples. For interpretability, these global analyses were followed by separate models for each country. In logistic regression models investigating the outcome *current PTSD* while considering trauma load and sex as well as their potential interaction, a significantly elevated risk was found for females in the Northern Ugandan sample. However, the effect was small compared to the large dose-dependent effect of trauma load (cf. Figure 2). Furthermore, in the Syrian sample, we found evidence for a sex × trauma load interaction effect, with the PTSD risk increasing more strongly for females with accumulating trauma load. No sex effects were observed in logistic regression models investigating current PTSD risk in the Rwandan and Sri Lankan sample. *Lifetime PTSD* was only investigated in the Ugandan and Rwandan sample and did not reveal any sex differences in logistic regression models considering trauma load and sex. This indicates that the initial PTSD risk after the conflict was similar in females and males in the Rwandan and Ugandan sample. Since a small sex effect was found in the Ugandan sample for current PTSD, it seems that spontaneous remission was more likely to occur in males, with females presenting more chronic PTSD trajectories.

### 4.1. The dose-response effect of cumulative trauma exposure

Across the different study populations, we observed a strong relationship between the number of trauma event types and the risk of developing PTSD in females and males, and this is in line with the well-known dose-response effect of trauma load (Catani et al., 2008; Kolassa et al., 2010; Mollica et al., 1998; Neuner et al.,

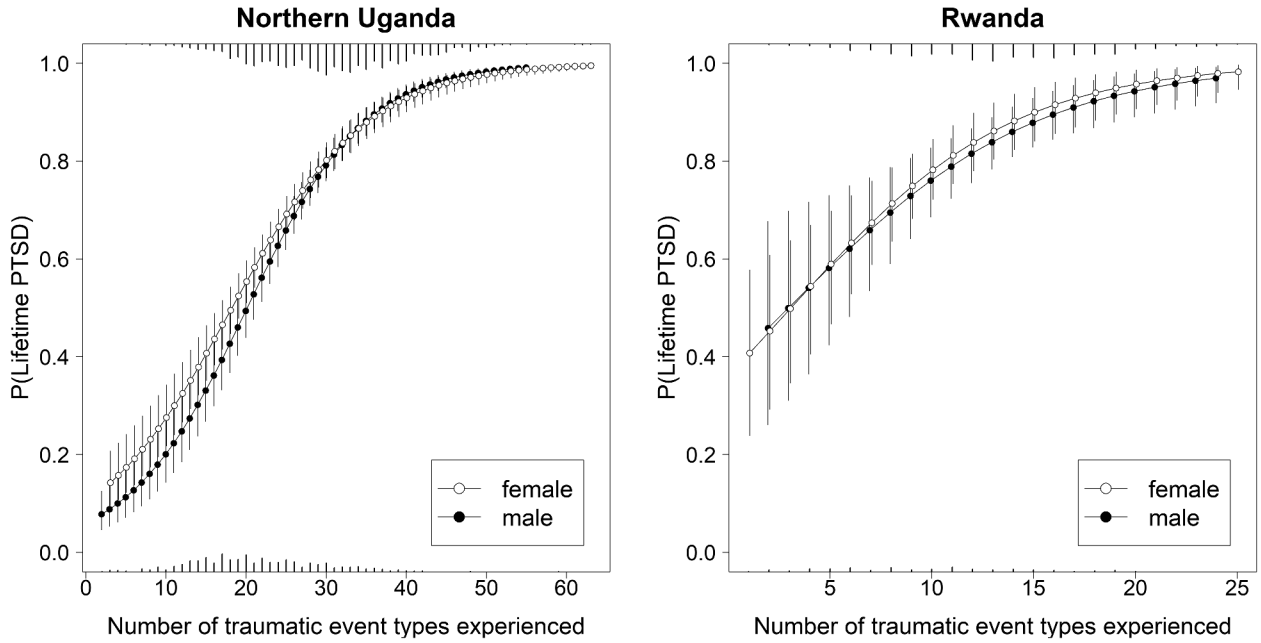


**Figure 3.** Fitted probabilities for lifetime PTSD as functions of trauma load and sex as well as their interaction, with bootstrapped pointwise CIs. Rug plots show histograms of lifetime traumatic load for lifetime PTSD patients (top of panels) and participants without current PTSD (bottom), and are to a common vertical scale. Note that lifetime PTSD was only assessed in the Northern Ugandan and Rwandan sample.

2004; Steel et al., 2009; Wilker et al., 2015). Our results are consistent with other studies from conflict survivors with high trauma exposure, which indicate that compared to the importance of trauma load in the prediction of PTSD risk, other individual risk and resilience factors might play a minor role (Wilker, Elbert, & Kolassa, 2014; Wilker & Kolassa, 2013). For instance, in studies considering trauma load, genetic risk factors only accounted for a relatively small share of the variance, whereas the dose-dependent effect explained the largest share of the variability in PTSD risk (e.g. Conrad et al., 2018; Wilker et al., 2013). Particularly at high levels of trauma load, inter-individual variability in PTSD risk is low, as almost everybody will develop PTSD (Neuner et al., 2004). Indeed, a recent investigation among Congolese refugees found sex differences in PTSD risk and reported that in the subgroup with very high trauma exposure, the differences between females and males vanished (Ainamani et al., 2020). Accordingly, sex differences in PTSD risk might be less pronounced in war-torn samples with high levels of trauma load due to ceiling effects. Similarly, in our investigation, the effect of sex on PTSD risk was smaller than expected and played a subordinate role compared to the large effect of trauma load. The only exception was the Syrian sample, in which the regression slope between trauma load and PTSD was steeper for females compared to males.

### 4.2. The role of trauma event type

In contrast to many studies investigating sex differences in PTSD risk which often focused on the civil population of industrialized countries, this paper investigated the civil population of war-torn countries. In all four samples, both females and males reported high exposure to war-related events (see Figures S2–S6), a type of event that has been associated with a high conditional PTSD risk (Kessler, 1995). Our results are partially in line with the meta-analysis of Tolin and Foa (2006), who found that in samples of participants who experienced combat, war, and terrorism, the differences between females and males were less pronounced than in samples of survivors of other types of trauma. In this account, some studies investigating PTSD within the military even failed to find a sex effect on PTSD risk (Hourani et al., 2016; Jacobson et al., 2015; Woodhead et al., 2012). One might argue that in countries living with peace, females and males are commonly exposed to different trauma event types. This might explain why – in contrast to our results – a recent study investigating sex differences in population-based samples from different countries with varying degrees of socioeconomic resources consistently observed the sex difference in PTSD risk across all samples (Dückers & Olff, 2017). In our four investigated samples, however, males and females were exposed to similar civil war experiences, potentially accounting for the observed reduced differences in PTSD vulnerability. Apart from that, it has often been argued that the higher PTSD risk in females can at least be partially accounted by the increased exposure to sexual violence (Gavranidou & Rosner, 2003). In the aforementioned study of Congolese

refugees with pronounced PTSD prevalence, females had a higher risk than males of developing PTSD when considering trauma load (Ainamani et al., 2020). However, it has to be noted that 56% of the interviewed females reported the experience of rape, compared to 15% of males. The conditional risk to develop PTSD after rape was similar in females and males, hence the higher prevalence of sexual violence in females might have strongly influenced the results (Ainamani et al., 2020).

In the Syrian, the Ugandan and the Rwandan sample, females reported a higher prevalence of sexual violence than males, whereas females and males were equally exposed to sexual assaults in the Sri Lankan sample. In line with the hypothesis that differences in exposure to sexual violence might impact the results, no sex differences in PTSD risk were found in the Sri Lankan sample. Yet, in the Syrian sample, the prevalence of sexual violence reported by females was lower than in the African samples. Therefore, different exposure to sexual violence cannot fully account for the differences between our study samples. However, it is important to note that in the Syrian context, reporting sexual violence is associated with high levels of community stigma, fear of disadvantage (e.g. establishing partnerships, job opportunities) and even threats to the safety of the survivors (e.g. honour killings), which renders it difficult to collect self-reported data regarding sexual violence (FIDH – International Federation for Human Rights, 2013). Furthermore, the assessment of sexual violence in the event list was not identical across samples (cf. Table 1) which makes it difficult to directly compare the frequencies between the samples.

### 4.3. Cultural differences in gender roles as an explanation of differences in PTSD risk?

While we observed less pronounced sex differences in PTSD risk in the investigated samples of conflict survivors than commonly described in the literature, the only sample with a clear sex effect on PTSD risk originated from Syria. As proposed by Norris et al. (2001), cultural differences in gender roles might contribute to sex differences in PTSD risk. A more recent review (Street & Dardis, 2018) highlights that gender is intrinsically tied to a number of PTSD risk factors. These includes the aforementioned higher risk of exposure to sexual violence in women. Furthermore, women might experience higher levels of chronic stress due to 'cumulative disadvantage' (Street & Dardis, 2018) caused by reduced opportunities including education, employment, and socioeconomic resources, which are associated with an increased vulnerability for mental health impairments including PTSD (Brewin, Andrews, & Valentine, 2000). Considering two global indices of gender inequality (the Gender Equity Index [GEI] and the Global Gender Gap Index [GGGI], of the samples included in this study, the highest gender inequality was documented for Syria (Social Watch, 2012; World Economic Forum, 2017). However, as we did not include a measurement of gender inequality or cultural perception of gender roles in our sample, the question whether higher sex differences in PTSD risk might be related to cultural differences in gender equality cannot be answered with our data.

### 4.4. Methodological considerations, strengths, and limitations

Strengths of the study include the large sample size of all four samples, the investigation of participants from four different countries, the employment of structured diagnostic interviews for PTSD, and the assessment of trauma load via detailed event-checklists that have been adapted for the local context. A limitation of the study is that data from four different research projects has been combined for the present analyses. Nevertheless, most of the employed methods are similar across samples. In all samples, the diagnostic interviews were conducted by intensely trained local interviewers supervised by expert psychologists experienced in the field of trauma research. Furthermore, all samples employed detailed event-lists. To capture the traumatic events relevant to a specific population, event-lists need to be adapted to the local context (Netland, 2005). Therefore, the employed event-lists are not identical. While all of them contain events like natural disasters, accidents, or sexual violence, the war-related events were adapted to the context of the respective conflict. Even though this reduces the direct comparability of the samples, it assured that the relevant traumatic experiences were captured in each sample (Netland, 2005). Further, the diagnostic interviews differed slightly between the populations. PTSD was assessed via the PDS (Foa et al., 1997) in the Rwandan, Ugandan, and Sri Lankan sample according to DSM-IV, whereas the PCL-5 (Weathers et al., 2013) based on DSM-5 was used in the Syrian sample. However, it has to be noted that since both instruments follow DSM-criteria, many items are similar in the PDS and PCL. Therefore, it seems unlikely that the higher PTSD prevalence in females observed in the Syrian sample is only due to a different diagnostic instrument. Further, more severe PTSD symptomatology in females was also evident in the subscore of intrusions, a symptom cluster that remained unchanged between DSM-IV and DSM-5. Furthermore, some demographic variables (i.e. age in the Rwandan, Sri Lankan and Syrian sample, and trauma exposure in all samples) differed between females and males, which makes it difficult to disentangle their effects on PTSD risk. Although we aspired to recruit an equal

proportion of participants from different regions in order to account for regionally varying degrees of trauma exposure (Sri Lankan sample) and tried to include individuals residing in different areas of the refugee camps (Rwandan, Ugandan, Syrian sample), the study populations cannot be considered representative for the respective conflict populations. Finally, the included samples vary substantially in the number of participants, and accordingly, the statistical power to detect sex differences differed between samples.

## 5. Conclusion

In war-affected samples, where females and males face similar and a high dose of traumatic events, the sex differences in PTSD risk seem to be lower than in general populations samples of Western countries. Across all samples, there was a strong and relatively similar dose-dependent effect of trauma load on PTSD risk for both males and females.

## Acknowledgments

We thank the local teams of interviewers for conducting the diagnostic interviews with highest empathy and professionalism. We acknowledge support for the publication costs by the Deutsche Forschungsgemeinschaft and the Open Access Publication Fund of Bielefeld University.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Funding

This work was supported by the German Research Foundation under [Grant KO 3895/4-1 and CA 632/3-1] as well as the Volkswagen Foundation under [Grant 91474-1].

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## Data availability statement

Due to the nature of this research, participants of this study did not agree for their data to be shared publicly, so supporting data is not available.

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