# Patterns of conflict-related trauma exposure and their relation to psychopathology: A person-centered analysis in a population-based sample from eastern DRC

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A B S T R A C T

Populations in war-torn regions are exposed to a wide array of traumatic events that can cause an enormous psychological burden. Individual characteristics influence the likelihood of being exposed to certain events, pointing to systematic interindividual differences in trauma exposure. However, there is a dearth of studies examining potential patterns of trauma exposure in war regions. In this cross-sectional epidemiological study, we applied a person-centered approach to identify patterns in the exposure to conflict-related traumatic events and determine their impact on commonly reported mental health problems in a population-based sample (N = 1000) from the eastern Democratic Republic of Congo. We implemented multi-stage random cluster sampling to randomly select adults from 100 villages. Of 1000 adults ($M_{age}$ = 43.19 years) included in the study, 50% were female. Results showed high prevalence of PTSD (17.0%), depression (27.8%), anxiety (25.4%) and suicidality (15.1%) following exposure to conflict-related traumatic events since 2002. Latent Class Analysis identified three distinct classes of trauma exposure: Class 1 "*low-trauma-exposure*" (51.4%, n = 514) was characterized by the lowest probabilities of trauma exposure. Class 2 "*non-physical-trauma*" (39.1%, n = 391) consisted of individuals with a high probability for exposure to non-physical trauma types only. Class 3 "*interpersonal-trauma*" (9.5%, n = 95) had the overall highest probability of exposure to traumatic events and was the only class affected by interpersonal-trauma types. Class membership was related to gender, age and place of living. Vulnerability to mental health problems increased from *low-trauma-exposure* to *non-physical-trauma* to *interpersonal-trauma class*. Our findings indicate that the exposure to traumatic events in conflict-affected populations underlies distinct patterns, with interpersonal trauma as a distinguishing marker. Vulnerability to psychopathology varies with trauma patterns, revealing patterns that include both non-physical and interpersonal traumata as most detrimental for mental health. Identification of underlying trauma patterns and their effects may improve mental health care in war-affected populations.

## 1. Introduction

Mental health research has highlighted the dire psychological burden for populations affected by armed conflict (De Jong and Komproe, 2002; Steel et al., 2009). Population-based epidemiological studies have revealed the full scale of detrimental outcomes. Across conflict-affected regions prevalence for psychopathology ranged from 11% to 50% for PTSD, 5%–40% for depression, 10%–40% for anxiety disorder and 11%–26% for suicidality (De Jong et al., 2003; Farhood and Dimassi, 2012; Johnson et al., 2008, 2010; Lopes Cardozo et al., 2000; Pham et al., 2004,

2010; Stammel et al., 2013). Exposure to conflict-related traumatic events proved to be a major risk factor (Charlson et al., 2012; Pham et al., 2004; Steel et al., 2009). The psychological consequences of these events are typically evaluated by means of variable-oriented approaches. These approaches analyze, among others, the effect of cumulative trauma exposure or of individual events. For instance, cumulative trauma exposure has been associated with increased vulnerability for PTSD and depression, also referred to as *dose-effect* relation (Farhood and Dimassi, 2012; Lopes Cardozo et al., 2000; Neuner et al., 2004; Pham et al., 2004). Similarly, individual types of traumatic events vary in their potential to

contribute to the development of mental health disorders (Johnson et al., 2008; Lopes Cardozo et al., 2000; Pham et al., 2004).

On closer inspection, both variable-oriented approaches have methodological limitations and may not reflect the reality of conflict-affected regions (O'Donnell et al., 2017). When investigating cumulative trauma exposure, aggregation of events leads to a loss of information about the actual experiences and in turn the simplistic assumption of identical effects of individual traumatic events (Hagan et al., 2016). Furthermore, analysis of cumulative trauma exposure does not reflect existing research suggesting systematic interindividual variations in the number and types of conflict-related trauma along socio-demographic lines, e.g. women facing higher risks to experience conflict-related sexual violence (Johnson et al., 2008, 2010; Pham et al., 2004). At the same time, examining the effects of individual trauma types also has limitations. For example, persons classified as exposed to a specific traumatic event may in fact have heterogeneous traumatic histories, ranging from single incident to long-term exposure that may include other types of trauma. Consequently, the prevailing variable-oriented approaches may not be able to adequately evaluate the complexity of trauma exposure and its effects in conflict-affected populations. A person-oriented approach, grouping individuals into classes of exposure, may be able to overcome some of the aforementioned limitations. It may capture more of the heterogeneity in trauma exposure and also provide the opportunity to gain insights into systematic interindividual patterns of traumatic histories and their consequences on the mental health of the general population of conflict-affected regions (O'Donnell et al., 2017; Sengoelge et al., 2019). Building in-depth knowledge from population-based studies about patterns of trauma exposure and their relation to the development of psychopathology is crucial for identifying specific vulnerable populations and tailoring effective psychological support (De Jong and Komproe, 2002; Gibbs et al., 2020; Lopes Cardozo et al., 2000). This is even more essential in unstable regions with recurring incidence of armed violence, where the availability of, and access to, psychological support is extremely limited.

The objectives of the present study were twofold. First, to obtain recent and representative data on the prevalence and association of conflict-related traumatic events and mental health problems among the general population of South Kivu, DRC, a region immensely affected by various armed groups. We focused on the commonly reported mental health problems after exposure to conflict, namely PTSD, depression, anxiety disorder and suicidality. We hypothesized strong relations between experienced trauma types and psychopathology. Second, to adequately unravel the complex relation between trauma exposure and psychopathology in conflict-affected populations, the aim of the current study was to identify common patterns of conflict-related trauma exposure in the general population. We hypothesized that different patterns of trauma exposure have distinct consequences for mental health. We expected to observe sociodemographic differences, particularly between gender and age groups, in the prevalence of specific trauma types, patterns of trauma exposure and psychopathology.

## 2. Method

### 2.1. Design and sampling

This research is based on a cross-sectional study conducted with a population-based sample (N = 1000) from South Kivu region in the eastern DRC from March to May 2017. South Kivu was chosen as the survey site, due to its large proportion of the population of eastern DRC and its central role in the Congo Wars (Johnson et al., 2010). A multi-level randomized cluster sampling approach (see Fig. 1) based on the administrative hierarchy of political subdivisions in the DRC was employed (De Juan and Koos, 2019). South Kivu region is in descending order subdivided into territories, sectors, groupings and villages. Initially, the study was to take place in all territories and sectors; however due to lack of comparability and acute security threats, two of eight
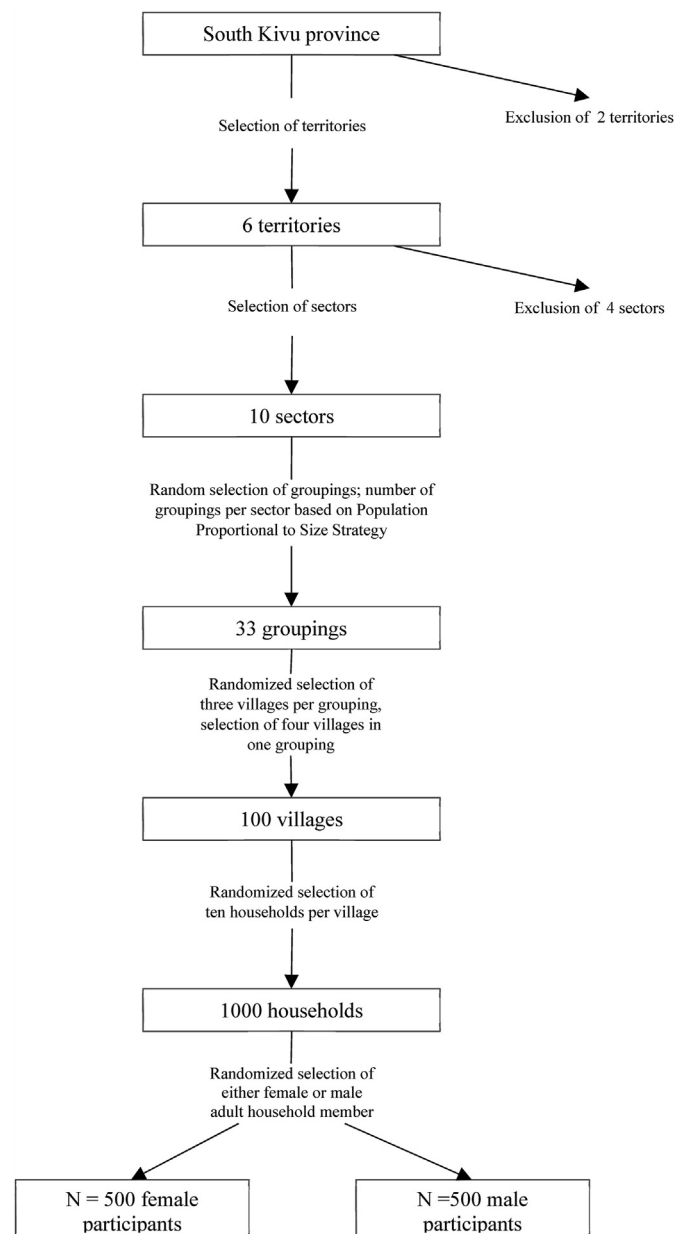


Fig. 1. Design and sampling procedures.

territories and four of 14 sectors of the remaining six territories were excluded from the sampling. In Shabunda territory inaccessibility due to ongoing armed conflict and lack of infrastructure prevented data assessment. Idjwi territory, an isolated island in Lake Kivu, was mostly unaffected by armed conflict and excluded from the sampling as it is therefore not comparable to the political and cultural structures in the other territories (Autesserre, 2017). 33 groupings were randomly chosen from the selected ten sectors. The number of selected groupings within each selected sector was calculated using Probability Proportional to Size sampling. From each selected grouping, three villages were selected at random (in one grouping four villages were sampled), resulting in the selection of 100 villages. Due to the unpredictable security situation, random sampling included three replacement groupings per sector and three replacement villages per grouping. For security reasons, ten percent of initially sampled villages had to be replaced with replacement villages. In each village ten households were randomly selected. Additionally, a list of five randomly selected replacement households per village was created beforehand, in case a household was not available. The initial

response rate on household level was 73%. The remaining households were substituted by replacement households. Within each household, the head of the household or their spouse was randomly selected. If none of them was available, any person ≥18 years was randomly chosen. Female enumerators interviewed women and male enumerators interviewed men. Data assessment took place with the assistance of a local research organization (Research Initiatives for Social Development, Bukavu, DRC). The multi-level randomized cluster sampling ensured representativity of the sample to the general population of South Kivu.

### 2.2. Participants and procedures

The team of experienced local researchers received a four-day workshop to familiarize with the specific methods, instruments and ethical guidelines used in this study. Introduction as well as questionnaire administration procedures were standardized, and consent of all participants was obtained orally prior to interviews. To evaluate the feasibility of questionnaire implementation, the questionnaires were pilot tested before survey administration. All measures were translated into French and Swahili and carried out verbally in one-to-one settings. In total 1000 participants between the age of 18 and 100 years (M = 43.19, SD = 16.83) completed the assessment. The sociodemographic characteristics can be found in Table 1. Ethical approval was granted by the Ethics Committee of the University of Konstanz, Germany.

### 2.3. Measures

*Traumatic Events.* Based on literature review of previous research from war-affected countries (Neuner et al., 2004; Farhood et al., 2006; Ibrahim and Hassan, 2017), including research from the DRC (Pham et al., 2010; Johnson et al., 2010; Ainamani et al., 2020), a list of six different trauma types was compiled (see Table 2). The selection includes trauma types with high and low prevalence and followed recommendations to reflect context-specific evidence (Netland, 2005). Individuals were asked to indicate direct experience of any of the traumatic events on this list. Events were only recorded if they occurred after 2002 and if they were related to violence by armed groups. Furthermore, an additional variable describing the witnessing of traumatic events was calculated by asking participants whether they witnessed any of the six trauma types

happening to another person.

*Refugee Health Screener (RHS-15).* The RHS-15 (Hollifield et al., 2013) includes four items based on three core PTSD symptoms clusters: Re-experiencing (two items), arousal (one item), and negative cognition and mood (one item). Items assessed symptoms occurring in the previous month and were rated on a five-point Likert scale from 0 (not at all) to 4 (extremely). When an item was rated 2 (moderately) or higher, the associated symptom cluster was considered to be present. Respondents screened positive for PTSD if all three symptom clusters were fulfilled and the DSM-5 A-criterion was met. In the current study, the DSM-5 A-criterion was met if the respondent reported direct exposure to or witnessing any of the events on the traumatic events list. The RHS-15 has previously been used in various conflict-affected populations, e.g. in samples from Iraq, Myanmar and Syria (Fellmeth et al., 2018; Hollifield et al., 2013; Kaltenbach et al., 2017). The Cronbach's alpha in the current study was 0.83.

*Patient Health Questionnaire (PHQ-4).* The PHQ-4 is an ultra-short screening tool for depression and anxiety (Kroenke et al., 2009). It is a well validated measure and has previously been used in similar cultural contexts, large-scale household surveys and with individuals affected by conflict (Kocalevent et al., 2014; Kuringe et al., 2019; Löwe et al., 2010). The questionnaire consists of two subscales (depression, anxiety) with two items each. Items are rated on a four-point Likert scale from 0 (not at all) to 3 (nearly every day). Scores ≥3 on the respective subscale indicated the heightened risk of a depressive or anxiety disorder. In our sample, the Cronbach's alpha was .73 and .72 for the depression and the anxiety subscale, respectively. In addition, participants were asked whether they have ever felt suicidal in the last twelve months ("*Have you felt suicidal in the last* 12 *months?*").

### 2.4. Data analysis

Statistical testing was conducted using IBM SPSS 26. Simple logistic regression analyses were used to calculate unadjusted Odds Ratios (OR) regarding the likelihood of psychopathology in relation to exposure to specific traumatic event types. Latent Class Analysis was conducted to identify classes of individuals with similar patterns of trauma exposure. Using the statistical software JMP®. Version 15 latent classes were constructed based on participants answers on seven binary variables

**Table 1**
Socio-demographics and prevalence rates of mental health disorders by trauma exposure class.

| | Overall sample N = 1000 N (%) | Low-trauma-exposure class | Non-physical- trauma class | Interpersonal- trauma class | $\chi^2$ (df) | p value |
|---|---|---|---|---|---|---|
| **Gender** | | | | | | |
| Female | 500 (50.0%) | 278 (54.1%) | 188 (48.1%) | 34 (35.8%) | 11.68 (2) | 0.003 |
| Male | 500 (50.0%) | 236 (45.9%) | 203 (51.9%) | 61 (64.2%) | | |
| **Age in years** | | | | | | |
| 18-29 | 260 (26.0%) | 143 (27.8%) | 98 (25.1%) | 19 (20.0%) | 10.90 (4) | 0.028 |
| 30-59 | 529 (52.9%) | 250 (48.6%) | 217 (55.5%) | 62 (65.3%) | | |
| 60-100 | 211 (21.1%) | 121 (23.5%) | 76 (19.4%) | 14 (14.7%) | | |
| **Education** | | | | | | |
| No school | 585 (58.5%) | 312 (60.7%) | 222 (56.8%) | 51 (53.7%) | 4.31 (4) | 0.366 |
| Primary School | 324 (32.4%) | 163 (31.7%) | 129 (33.0%) | 32 (33.7%) | | |
| Secondary School | 91 (9.1%) | 39 (7.6%) | 40 (10.2%) | 12 (12.6%) | | |
| **Household income (per month)** | | | | | | |
| Less than 24.35 $ | 759 (75.9%) | 399 (77.6%) | 288 (73.7%) | 72 (75.9%) | 5.30 (4) | 0.258 |
| 24.35–48.69 $ | 162 (16.2%) | 84 (16.3%) | 64 (16.4%) | 14 (14.7%) | | |
| More than 48.70 $ | 79 (7.9%) | 31 (6.0%) | 39 (10.0%) | 9 (9.5%) | | |
| **Distance household to village center** | | | | | | |
| Less than 2 km | 617 (61.7%) | 322 (62.6%) | 234 (59.8%) | 61 (64.2%) | 13.32 (4) | 0.010 |
| 2–5 km | 236 (23.6%) | 132 (25.7%) | 91 (23.3%) | 13 (13.7%) | | |
| More than 6 km | 147 (14.7%) | 60 (11.7%) | 66 (16.9%) | 21 (22.1%) | | |
| **Psychological Outcomes** | | | | | | |
| PTSD | 170 (17.0%) | 53 (10.3%) | 89 (22.8%) | 28 (29.5%) | 35.97 (2) | 0.000 |
| Depression | 278 (27.8%) | 128 (24.9%) | 120 (30.7%) | 30 (31.6%) | 4.45 (2) | 0.108 |
| Anxiety | 254 (25.4%) | 110 (21.4%) | 107 (27.4%) | 37 (39.9%) | 14.38 (2) | 0.001 |
| Suicidality | 151 (15.1%) | 67 (13.0%) | 53 (13.6%) | 31 (32.6%) | 25.21 (2) | 0.000 |

**Table 2**

Lifetime prevalence of various traumatic experiences.

| | Total (N = 1000) | | Women (N = 500) | | Men (N = 500) | | Sex Difference | 18–29 yrs (N = 260) | | 30–59 yrs (N = 529) | | 60–100 yrs (N = 211) | | Age Difference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Traumatic Experiences | n | % | n | % | n | % | $\chi^2$ | n | % | n | % | n | % | $\chi^2$ |
| Experience of any Event | 696 | 69.6 | 341 | 68.2 | 348 | 71.0 | 0.93 | 174 | 66.9 | 389 | 73.5 | 133 | 63.0 | 9.05** |
| Witness of any traumatic event | 678 | 67.8 | 289 | 57.8 | 389 | 77.8 | 45.80*** | 166 | 63.8 | 377 | 71.3 | 135 | 64.0 | 6.18* |
| Displacement | 607 | 60.7 | 296 | 59.2 | 311 | 62.2 | 0.94 | 155 | 59.6 | 338 | 63.9 | 114 | 54.0 | 6.33* |
| Burning or looting of home or property | 452 | 45.2 | 222 | 44.4 | 230 | 46.0 | 0.26 | 110 | 42.3 | 258 | 48.8 | 84 | 39.8 | 6.08* |
| Murder of relative | 173 | 17.3 | 79 | 15.8 | 94 | 18.8 | 1.57 | 46 | 17.7 | 100 | 18.9 | 27 | 12.8 | 3.97 |
| Serious injury by armed attack | 58 | 5.8 | 22 | 4.4 | 36 | 7.2 | 3.59 | 10 | 3.8 | 37 | 7.0 | 11 | 5.2 | 3.33 |
| Abduction | 44 | 4.4 | 8 | 1.6 | 36 | 7.2 | 18.64*** | 10 | 3.8 | 29 | 5.5 | 5 | 2.4 | 3.73 |
| Experienced Rape | 13 | 1.3 | 13 | 2.6 | 0.0 | 0.0 | 13.17*** | 5 | 2.0 | 7 | 1.3 | 1 | 0.5 | 1.91 |

*Note.* *p < .05. **p < .01. ***p < .001.

measuring the exposure to traumatic events. We identified the most appropriate number of classes by considering commonly used information criteria as well as the theoretical adequacy and utility of the class solution. Information criteria used for model selection were the Bayesian Information Criterion (BIC), Sample-size Adjusted Bayesian Information Criterion (SABIC), Akaike Information Criterion (AIC), and the Consistent Akaike Information Criterion (CAIC). Running the analysis with a set of random start values lead to identical solutions, suggesting that the model has converged on the global maximum of the likelihood function. Individuals were categorized into the classes based on their largest posterior probability estimate across classes. This *maximum-probability assignment* does not take uncertainty in class assignment into account, as it treats the most likely class as the true class to which an individual belongs (Bray et al., 2015). The potentially occurring classification error can lead to bias in the estimates of subsequent analyses, e.g. regression models (Bray et al., 2015). In studies with large sample size, i.e., N > 500, and well distinguished classes, i.e., mean posterior probability of class membership for each class exceeding 0.7–0.9, regression models with latent classes are little affected by classification error (Elliott et al., 2020; Nagin, 2005). In the current study, the average posterior probabilities for individuals assigned to each class ranged from 0.76 to 0.95, indicating the majority of orders were likely to be in a given class and not warranting to control for classification uncertainty (Nagin, 2005). Multiple logistic regression models were conducted for each psychopathological outcome, using trauma exposure class as primary prediction variable, and sociodemographic information as control variables. Adjusted ORs were reported to describe the likelihood of psychopathology depending on class membership and control variables. Necessary assumptions for logistic regression analysis, including linearity of logits, absence of multicollinearity and lack of influential outliers, were met for all models.

## 3. Results

### 3.1. Prevalence of conflict-related traumatic events

In total 69.6% (n = 696) of respondents directly experienced at least one traumatic event involving armed groups since 2002. Furthermore, 67.8% (n = 678) of respondents witnessed at least one traumatic event type happening to other people. Table 2 shows the prevalence for the different traumatic event types by gender and age group. Women reported being a victim of rape more often, while the frequency of abduction and witnessing of events was higher for men. Age group differences were found for burning or looting of home or property, displacement, and witnessing of events. The exposure to traumatic event types was most prevalent in the age group of 30–59 years old.

### 3.2. Prevalence of psychopathology and the association with specific traumatic events

In total, 17.0% (n = 170) of the sample displayed post-traumatic stress symptoms at a level indicating potentially clinically relevant symptoms of PTSD. Results further showed that 27.8% (n = 278) and 25.4% (n = 254) of participants screened positive for depression and anxiety, respectively. Furthermore, 15.1% (n = 151) of participants reported to feel suicidal. The conditional prevalence and unadjusted ORs for psychopathology across the individual trauma types are documented in the supplementary files (see eTable 1). The unadjusted ORs indicated that six of the seven traumatic event types, including the witnessing of events, were associated with an increased risk of psychopathology. Only the experience of abduction did not show an increased risk of mental health problems in the sample. Being a victim of rape by armed personnel showed the strongest association with each PTSD, depression, and anxiety and suicidality.

### 3.3. Classifying trauma exposure

Latent class models with two to six classes were analyzed to classify participants by their exposure to traumatic events (eTable 2). The three-class solution was selected for further analyses based on the information criteria (eFig. 1) and theoretical considerations. The estimated and observed conditional probabilities for each traumatic event are listed in eTable 3. The class profiles based on the observed conditional probabilities for the three-class solution are presented in Fig. 2. Accordingly, class 1 (51.4%, n = 514) included individuals with the lowest probabilities of exposure to traumatic events (0%–46%). This class was labeled *low-trauma-exposure class*. Individuals in class 2 (39.1%, n = 391) were primarily characterized by high probabilities of exposure to non-physical violence types, i.e., exposure to burning/looting of home or property (93%), displacement (89%), murder of close persons (31%), and witnessing traumatic events (89%). The probability of exposure to interpersonal traumatic event types was, similar to class 1, almost zero. Class 2 was therefore labeled *non-physical-trauma class*. In class 3 (9.5%, n = 95) probabilities were high for non-physical trauma types and additionally the highest for interpersonal trauma types, i.e., being injured (60%), abducted (46%), and raped (14%) by armed groups. This class was thus labeled *interpersonal-trauma class*.

Table 1 presents socio-demographic information and prevalence of mental health disorders for the three classes. The *interpersonal-trauma class* had a significantly higher proportion of men, consisted to a greater extent of middle-aged (30–59 years) respondents and lived further away from the village center. Furthermore, the prevalence of clinically significant symptoms of PTSD, anxiety and suicidality increased from *low-trauma-exposure* to *non-physical-trauma* to *interpersonal-trauma class*. No significant differences were found for depression.

### 3.4. Predicting psychopathology with trauma-exposure class

To examine the relation between class membership and psychopathology, four separate logistic regressions were conducted with the prospective diagnosis of PTSD, depression, anxiety and suicidality as outcome variables. Each regression model included participants' age, education, household income and distance to village center as control
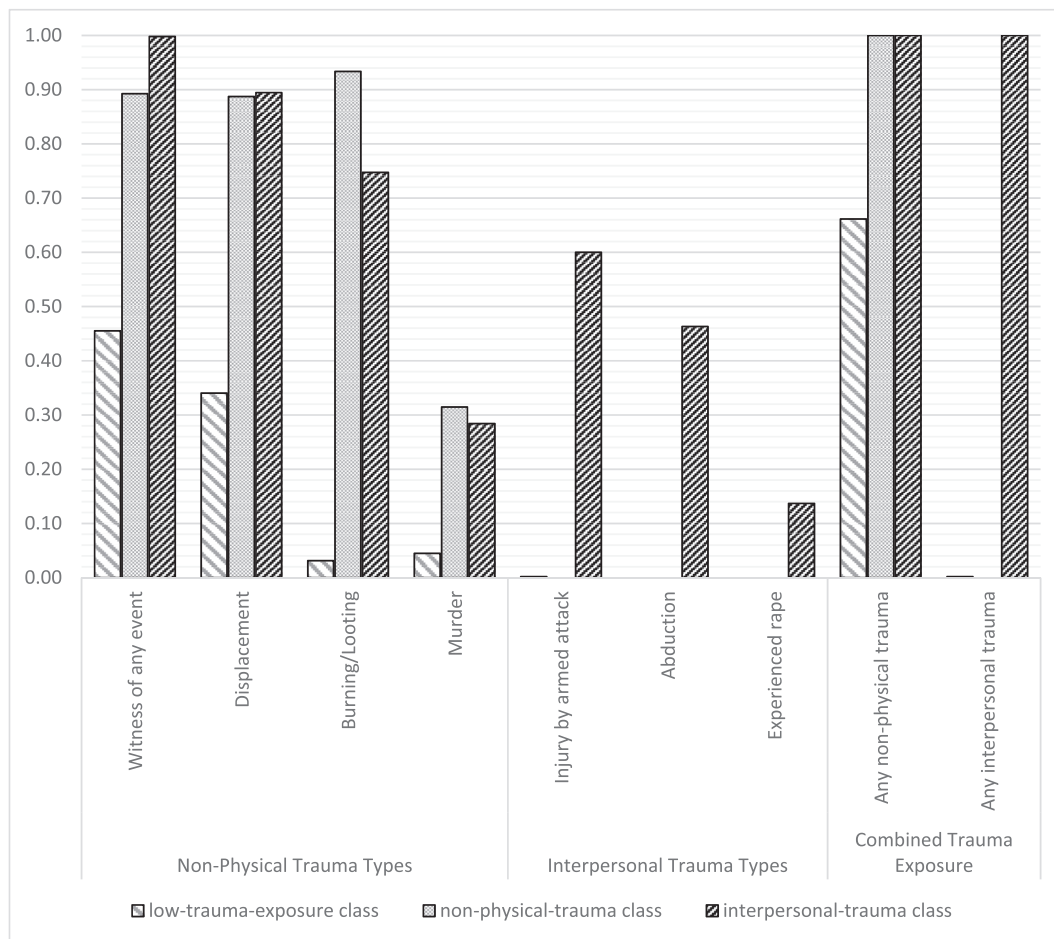
**Fig. 2.** *Observed probabilities of conflict-related trauma exposure by class membership in a three-class solution.*

variables. Our results showed a constant increase in the risks for psychopathology from *low-trauma-exposure* to *non-physical-trauma* to *interpersonal-trauma class* (see Table 3). Using the *low-trauma-exposure class* as reference category, membership in the *non-physical-trauma class* increased risks for PTSD, depression and anxiety. Similarly, individuals in the *interpersonal-trauma class* showed significantly increased risks for PTSD, depression, anxiety, but also suicidality compared to the *low-trauma-exposure class*. Furthermore, comparing individuals from the *non-physical-trauma* and the *interpersonal-trauma class* revealed higher risks for PTSD, anxiety, and suicidality in the latter class. Being female significantly increased the risks for all mental health problems. Higher education and household income significantly decreased the risk for suicidality.

## 4. Discussion

This study investigated the prevalence of traumatic experiences and mental health problems in a representative sample of the general population from conflict-affected South Kivu, providing recent data from a continuously unstable post-conflict setting. Consistent with previous population-based epidemiological studies from post-conflict settings, our findings showed high prevalence of traumatic experiences in a war-affected population (De Jong et al., 2001; Pham et al., 2004). The tremendous trauma exposure represents a high psychological burden for the population, which reflects in elevated screening rates of mental health problems (De Jong et al., 2003; Johnson et al., 2008; Lopes Cardozo et al., 2000).

Acknowledging the complexity of trauma exposure in conflict-affected populations, we implemented a person-oriented analysis

approach to adequately disentangle the relation between trauma exposure and mental health outcomes. This resulted in the identification of classes of individuals with shared trauma histories and the determination of classes most vulnerable to mental health problems. We found three distinct classes of individuals: those who experienced low trauma exposure (*low-trauma-exposure class*), those affected by non-physical trauma types only (*non-physical-trauma class*) and those subjected to non-physical and additionally interpersonal trauma types (*interpersonal-trauma class*). The markers distinguishing between classes were the number of experienced trauma types, but also the type of trauma exposure itself, i.e., non-physical trauma and interpersonal trauma. Especially the *interpersonal-trauma class* featured an alarmingly high likelihood of being exposed to multiple traumata, including non-physical events, and as the only class the occurrence of interpersonal trauma types. Our findings are concurrent with person-centered research, including studies with war-affected samples, which found similar distinct trauma patterns based on the presence of interpersonal traumata (Gibbs et al., 2020; O'Donnell et al., 2017; Sengoelge et al., 2019). However, these studies have either examined samples not living in war-affected areas anymore (e.g., refugees (Sengoelge et al., 2019)) or only subgroups of the population (e.g., women (Gibbs et al., 2020)). Compared to studies with refugees, our identification of trauma patterns is specifically based on the experiences of events within a war-affected region, i.e., our identified patterns are free of an influence of (post-) migration associated traumatic experiences and thus more specific to populations living in war-affected areas. Moreover, our representative sample including both women and men, extends existing evidence of studies conducted within war-affected regions for further population subgroups and allows for the examination of gender effects in trauma patterns. Regarding the composition of the

**Table 3**
Adjusted Odds Ratios of Variables associated with PTSD, Depression, Anxiety and Suicidality.

| | PTSD OR (95% CI) | Depression OR (95% CI) | Anxiety OR (95% CI) | Suicidality OR (95% CI) |
|---|---|---|---|---|
| Trauma Class | | | | |
| non-physical vs. low-exposure | 3.10*** (2.10–4.57) | 1.50* (1.10–2.05) | 1.54** (1.12–2.12) | 1.18 (0.79–1.76) |
| interpersonal vs. low-exposure | 5.80*** (3.25–10.32) | 1.81* (1.09–3.00) | 3.24*** (1.97–5.33) | 4.43*** (2.57–7.66) |
| interpersonal vs. non-physical | 1.87* (1.09–3.22) | 1.20 (0.72–2.00) | 2.11** (1.29–3.46) | 3.76*** (2.15–6.57) |
| Gender (female) | 3.94*** (2.55–6.10) | 3.14*** (2.24–4.42) | 3.26*** (2.28–4.65) | 2.00** (1.31–3.07) |
| Age | 1.00 (0.99–1.01) | 1.00 (0.99–1.01) | 1.00 (0.99–1.01) | 1.00 (0.99–1.01) |
| Education | | | | |
| None | Reference category | | | |
| Primary School | 0.60* (0.38–0.94) | 0.80 (0.56–1.14) | 1.00 (0.70–1.45) | 0.42** (0.26–0.70) |
| Secondary School | 0.49 (0.20–1.17) | 0.60 (0.31–1.15) | 0.67 (0.34–1.33) | 0.34* (0.13–0.91) |
| Household income (per month) | | | | |
| Less than 24.35 $ | Reference category | | | |
| 24.35–48.69 $ | 1.43 (0.87–2.35) | 0.80 (0.52–1.22) | 0.90 (0.58–1.39) | 0.54* (0.29–0.98) |
| More than 48.70 $ | 1.13 (0.53–2.41) | 1.01 (0.55–1.86) | 1.12 (0.61–2.06) | 0.09* (0.01–0.69) |
| Distance household to village center | | | | |
| Less than 2 km | Reference category | | | |
| 2–5 km | 1.03 (0.68–1.60) | 0.57* (0.40–0.82) | 0.93 (0.65–1.33) | 0.64 (0.40–1.01) |
| More than 6 km | 0.65 (0.38–1.11) | 0.59* (0.38–0.92) | 0.77 (0.49–1.19) | 0.70 (0.41–1.20) |

*Note.* *p < .05. **p < .01. ***p < .001.

trauma classes, it is noteworthy that in the current study only the *interpersonal-trauma class* reported exposure to sexual violence and abduction. In previous studies with war-affected samples, the trauma classes mostly differed in their probability of exposure to traumatic events but not the presence of certain event types (Gibbs et al., 2020; Sengoelge et al., 2019). In the current study, the observation of a clear distinction of trauma patterns based on the presence of certain trauma types (i.e., interpersonal trauma) offers a more nuanced picture. Our findings indicate that sexual violence and abduction are rarely single events, but rather accompanied or preceded by other severe types of interpersonal trauma. Furthermore, the composition of the classes showed that men, middle-aged and those who stay far from village centers may be predisposed to higher exposure to violence by armed groups including interpersonal trauma.

Focusing on the psychopathological consequences of the trauma exposure patterns, we observed significant differences in the probabilities of developing mental health problems. The risk of mental health problems increased as the exposure to trauma types increased, rendering those exposed to both non-personal and interpersonal trauma types as most vulnerable to psychopathology. This replicates findings of an association between the number of trauma types and an increased symptomatology of mental health problems (i.e. *dose-effect*), but also suggests that the level of psychopathology varies with the type of exposure (Farhood and Dimassi, 2012; Lopes Cardozo et al., 2000). More specifically, our findings revealed that trauma histories involving the exposure to interpersonal trauma types, such as rape and injury by armed attack, are more detrimental for mental health outcomes than trauma histories encompassing non-physical trauma types only. These findings highlight the relevance of taking into account not only the number of trauma types, but also common trauma histories in which trauma types co-occur to build nuanced models of vulnerability to psychopathological outcomes.

Furthermore, we found gender differences in the vulnerability to mental health problems. Despite men being more likely to be grouped in the *interpersonal-trauma class*, women were more likely to develop symptoms of PTSD, depression, anxiety or suicidality. This inverse relation between gender and trauma exposure and gender and psychopathology mirrors the conclusion of studies describing lower risks to experience traumatic events, but a higher PTSD symptom severity for women (Sengoelge et al., 2019; Tolin and Foa, 2006). A higher vulnerability to mental health problems has also been observed among female refugees from eastern DRC (Ainamani et al., 2020). In a systematic analysis, such gender differences were attributed to differences in pre-, peri-, and posttraumatic risk factors, including type of traumatic experience, peritraumatic fear and helplessness, and negative posttraumatic cognitions (Christiansen and Hansen, 2015). Regarding the increased exposure of women to sexual violence and the associated powerful negative emotions and cognitions, these risk factors may be a plausible explanation for the gender differences found in the present study. Context-specific factors, such as high levels of stigmatization and daily stressors, e.g., inadequate medical care, may further contribute to vulnerability to mental health problems among female victims of sexual violence from Eastern DRC (Verelst et al., 2014a, 2014b).

### 4.1. Strengths and limitations

The implemented person-oriented approach in a population-based sample complements existing post-conflict research with several benefits and contributes to a more comprehensive picture of the lived reality in post-conflict settings (O'Donnell et al., 2017). Firstly, it offers more information about the heterogeneity of trauma exposure in conflict-affected populations than the analysis of cumulative trauma exposure. Secondly, it describes shared patterns of trauma experience among the population caused by the presence of armed groups, instead of focusing on the exposure to single traumatic events. And thirdly, it offers more differentiated explanations for differences in the prevalence of psychopathology beyond the study of cumulative and isolated traumatic events. Lastly, analytical inclusion of socio-demographic characteristics allows for the determination of population strata-specific vulnerabilities for trauma exposure and mental health problems. However, some important limitations must be noted: The data for this study were collected in six of eight territories of South Kivu. Insecurity at the time of data collection limited the access to ten percent of the sampled villages, which were replaced using the initial sampling procedure. It is likely, that residents of these insecure areas have experienced high levels of violence, which may not be reflected by the observations in the replacement villages. The instruments used to measure mental health problems and trauma exposure, although validated in non-western samples and for use in studies like this (Kaltenbach et al., 2017; Kocalevent et al., 2014; Löwe et al., 2010; Neuner et al., 2004), have been developed for screening purpose and do not substitute for diagnoses determined by clinicians. The use of mental health screening instruments as opposed to structured diagnostic interviews may lead to an overestimation of prevalence rates in the current study (Levis et al., 2020; Tsai, 2014). Furthermore, the validity of the assessment of suicidal ideation as well as the experience of rape may be limited by the use of single-item measures. Regarding the experience of rape, previous studies have reported higher prevalence rates in samples from the DRC using more detailed measures (Johnson et al., 2010). Utilizing standardized instruments and following detailed measurement guidelines for the assessment of suicidality and sexual violence can reduce potential bias and the risk of misclassifications in future studies (World Health Organization, 2019). As data for this study was assessed in self-report, it may generally not be free of potential bias, e.g., recall-bias or social-desirability. Nevertheless, pre-tests indicated participants' comprehension and disclosure to all questions, including the single items on rape and suicidal ideation, in the current cultural context. In addition, although we provided up-to-date information on the prevalence of traumatic events in the general population of South Kivu, our

analyses did not include monitoring for events before 2002. Despite dating back many years, these experiences may have influenced the predisposition to mental disorders in the current study. Furthermore, we only recorded a range of possible traumatic events, which does not make our assessment exhaustive and does not preclude exposure to other traumatic events. Moreover, other aspects of trauma exposure, such as severity, frequency, and duration, may provide incremental value in understanding patterns of trauma exposure, but were not considered in this study. However, the prevalence of traumatic events and the effects on mental health in the current study were largely consistent with previous reports (Johnson et al., 2010; Pham et al., 2010). Moreover, use of a multi-stage randomized cluster sampling procedure and large sample size have been found to minimize biases in mental health problems prevalence rates (Steel et al., 2009).

### 4.2. Implications

The high trauma burden in the population poses an enormous challenge to the porous health systems of war-affected countries (De Jong and Komproe, 2002). Our approach to analyze trauma histories highlights the diverse mental health needs of populations in post-conflict settings, thus placing the implementation of population needs-based approaches into the focus of research and policies. To adequately address the complex needs and overcome shortages in mental health-care workforce, this may include decentralized and community-oriented interventions, such as the training of community-based lay personnel (De Jong and Komproe, 2002; Ertl et al., 2011). Provision of special treatment services for those most at risk for psychopathology, such as treatment centers for violence-affected women, may further facilitate treatment access for vulnerable groups. Moreover, given the multifaceted impact of different trauma histories on psychopathology, increased attention to traumatic experiences is indicated for the clinical practice. Therefore, health-care providers in post-conflict regions should implement extensive screening procedures with a special emphasis on interpersonal traumatic events. The treatment of psychopathological symptoms, not only PTSD, in post-conflict settings can benefit from the inclusion of trauma-focused interventions (Robjant and Fazel, 2010).

## 5. Conclusions

This is one of the first studies to implement a person-centered approach for the analysis of trauma exposure in a representative sample living in a conflict-affected region. Our findings revealed distinct patterns of exposure to traumatic events in the population of eastern DRC, primarily differentiated by the number of trauma types and the presence of interpersonal trauma. Thus, this is the first study showing that populations in (post-) conflict regions are comprised of different subgroups regarding their trauma exposure. Analyses of the relation between trauma patterns and mental health provided nuanced insights into vulnerability to psychopathology, beyond the analysis of cumulative trauma exposure and isolated trauma types. The study has important clinical implications by identifying a gradual increase in the risk of suffering from mental disorders depending on the trauma history, with trauma histories that include both non-physical and interpersonal traumata as most detrimental for mental health outcomes.

## CRediT authorship contribution statement

**Lars Dumke:** Conceptualization, Methodology, Software, Formal analysis, Writing – original draft, Writing – review & editing, Visualization. **Roos van der Haer:** Conceptualization, Validation, Writing – review & editing. **Carlo Koos:** Validation, Investigation, Resources, Writing – review & editing, Funding acquisition, Project administration. **Tobias Hecker:** Conceptualization, Methodology, Formal analysis, Resources, Writing – original draft, Writing – review & editing, Supervision.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https:// doi.org/10.1016/j.ssmmh.2021.100005.

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