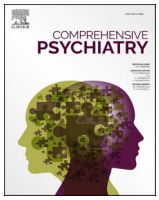
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Psychiatric comorbidities of posttraumatic stress disorder among adolescent refugees in Uganda: A latent class analysis of patterns and covariates

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ABSTRACT

Background: Although psychiatric comorbidities are common among trauma-exposed individuals with PTSD, their patterns and covariates among refugee adolescents in low-resource settings remain understudied. This study aimed to identify distinct patterns of psychiatric comorbidities and their associated factors among adolescent refugees with PTSD in Nakivale refugee settlement, Uganda.

Methods: In this cross-sectional study, 325 refugee youth were assessed on various PTSD psychiatric comorbidities and covariates of (age, gender, war trauma, post-migration stressors) using MINI International Neuropsychiatric Interview 7.02 and standardized measures of war trauma and post-migration stressors. Latent class analysis (LCA) was used to identify patterns and covariates of comorbidity.

Results: Of 269 adolescents with PTSD, 97% had at least one comorbid disorder: panic disorder (88.9%), generalized anxiety disorder (84%), agoraphobia (75.1%), depressive disorder (62.8%), obsessive compulsive disorder (60.6%), attention deficit disorder (43.9%), oppositional defiant disorder (40.9%), conduct disorder (33.8%), and alcohol use disorder (10.8%). LCA revealed three classes: low-moderate comorbidity (n = 66, 24.5%), high internalizing comorbidity (n = 101, 37.5%) with high probabilities of depression and anxiety disorders, and high overall comorbidity (n = 102, 37.9%) with relatively high probabilities of all disorders. The high overall comorbidity class had more girls than the other two classes. Both high comorbidity classes had higher war trauma and post-migration stressors than the low-moderate comorbidity class.

Conclusions: Adolescent refugees with PTSD exhibit high psychiatric comorbidity that clusters in distinct patterns. These findings highlight the need for interventions that address the identified comorbidity patterns, consider gender disparities, and account for cumulative trauma and post-migration stressors to effectively support traumatized youth.

1. Background

Post-traumatic stress disorder (PTSD) is a debilitating mental health condition that arises following exposure to traumatic events, such as interpersonal violence, accidents or disasters. Research primarily conducted in Western high income countries (HICs) shows high comorbidity of PTSD with other psychiatric disorders, particularly internalizing disorders like depression, anxiety disorders and obsessive-compulsive disorder, as well as externalizing disorders such as conduct disorder, attention deficit disorder, oppositional defiant disorder and substance use disorders [19,45,55,72,77,96]. Trauma exposure represents a transdiagnostic risk factor influencing multiple psychological and

Abbreviations: PTSD, Post Traumatic stress disorder; LMICs, Low- and middle-income countries; OPM, Office of the Prime Minister.

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biological processes [26,58]. PTSD comorbidities worsen mental health outcomes, increasing distress, functional impairment, and suicide risk while reducing treatment effectiveness [30,31,34,47,52,53].

Psychiatric research has increasingly adopted person-centered approaches, such as latent class analysis (LCA) and latent profile analyses (LPA), to examine patterns or profiles of psychiatric comorbidity across a broader range of disorders [25,92]. These approaches aim to identify subgroups of individuals based on their similarities in a set of key characteristics, considering that individuals may exhibit variable and heterogeneous patterns of comorbidity that would not be detected by variable-centered analyses, e.g., factor or regression analysis [25,49]. These analyses also offer the possibility of identifying covariates of patterns of comorbidity, which represent potential targets for screening, prevention and treatment programs to address psychiatric comorbidity.

Studies using LCA/LPA to understand PTSD comorbidities have been conducted primarily with adults in Western HICs. These studies have identified between two and 13 distinct comorbidity subgroups, typically characterized by one subgroup with relatively low comorbidity and one or more subgroups with higher comorbidity [29,30,35,62,77,78,88]. Given that many psychiatric disorders have their onset in adolescence - a period characterized by significant physical, emotional, and social changes [71,86] - studies focusing on this age group are critical for informing prevention and early treatment strategies. Among youth in various contexts, latent classes characterized by exposure to a greater variety of traumatic events are associated with higher levels of PTSD symptoms and internalizing and externalizing problems among their members [22,33,70]. Furthermore, classes defined by more complex posttraumatic symptomatology - such as a dissociative subtype of complex PTSD [98] or combined PTSD with developmental trauma disorder [28] - exhibit higher comorbidity with other psychiatric disorders. Finally, person-centered analyses of general psychiatric comorbidity in Western adolescent samples [9,25,99] consistently identify classes characterized by relatively low comorbidity, high internalizing comorbidity, and high combined internalizing-externalizing comorbidity. It is important to note that the methodologies across person-centered studies are heterogeneous, involving variations in the number and types of diagnostic indicators, assessment modes (e.g., clinical interview, self-report, teacher-report) and specific measures, which should be considered when interpreting and comparing the identified patterns.

To date, there is very limited research on PTSD comorbidities among refugee populations, despite their particularly vulnerability to mental health problems due to exposure to multiple traumatic events and ongoing stressors following displacement [7,59,80]. The majority of the world's refugees live in low- and middle-income countries (LMICs), often in refugee camps, where post-migration stressors involve insecurity and resource scarcity. The multiple stressors associated with refugee camps —such as ongoing violence, social isolation, and limited access to resources and services —may further exacerbate PTSD and its comorbid conditions [59,97].

Studies report high comorbidity of PTSD with depression and anxiety in adult refugees, both in HICs [4,8,61,66,85] and LMICs [5,17,40]. However, a systematic review noted only two small-sample studies on comorbidities of PTSD in refugee minors [10]. One of these observed high comorbidity between PTSD and ADHD among children of traumatized Iraqi parents resettled in Sweden [21], while the other reported relatively low comorbidity of PTSD with depression (7.3%) and anxiety (3.6%) in Yazidi refugee children and adolescents resettled in Turkey [64].

The few studies that have used person-centered analyses in refugee samples have been conducted mainly with adults living in Western HIC. Most have focused on patterns of trauma exposure [74,83] and post-migration stressors [14], linking the derived classes to mental health outcomes, or on PTSD symptom profiles [6,60]. Fewer have examined subgroups based on PTSD comorbidity. Those that have identified three to four subgroups differing in symptom severity [42,50], but these studies focused on a limited range of internalizing disorders. Across these analyses, higher trauma exposure, higher levels of post-migration stressors, and female gender were consistently related to more severe psychopathology [14,42,50,60,83].

Understanding PTSD comorbidities among adolescent refugees living in low-resource settings is crucial, as the interplay of trauma, displacement, and resource scarcity may create unique comorbidity patterns that differ from those observed in higher-resource settings or adult populations. However, to date, no study has examined the patterns and covariates of PTSD comorbidity in adolescent refugees within this specific context, despite their high risk of exposure to severe trauma and other stressors during a crucial developmental stage. Prior person-centered studies in adult refugee populations have been limited in diagnostic breadth, focusing primarily on internalizing disorders. Elucidating these comorbidities is vital due to their documented long-term impact on health and socioeconomic outcomes [32,38,95]. Therefore, to address these gaps, the present study drew on a sample of adolescent refugees living in the Nakivale refugee settlement in Uganda, pursuing the following three objectives: 1) Analyzing the rates of co-morbidity of PTSD with a broad range of internalizing (depression, generalized anxiety disorder, panic disorder, agoraphobia, obsessive-compulsive disorder) and externalizing disorders (conduct disorder, oppositional defiant disorder, ADHD, alcohol use disorder) on a descriptive level. 2) Examining the patterning of psychiatric comorbidity of PTSD using LCA. 3) Identifying covariates of comorbidity classes resulting from LCA as potential targets for prevention and treatment approaches.

Given the high co-occurrence of PTSD with other disorders among non-refugee children and adults (e.g., [19,45,96]) and adult refugees (e.g., [4,4,40]), we hypothesized high rates of psychiatric comorbidity of PTSD in our sample, especially for internalizing disorders. Based on observed patterns of comorbidity of PTSD among adults with and without a refugee background [30,42,50,78], we hypothesized that there would be distinct comorbidity classes. Furthermore, person-centered studies of general psychiatric comorbidity in adolescent samples consistently identify a subgroup characterized by both internalizing and externalizing symptoms [9,25,99]. Therefore, we anticipated that a class with significant externalizing comorbidity would most likely co-occur with high internalizing symptoms, rather than appearing as a purely externalizing profile. However, given the lacking evidence on patterns of comorbidity of PTSD in refugee adolescents, we did not have specific hypotheses on which disorders would occur in specific classes. We also hypothesized that higher trauma exposure, post-migration stressors, and female gender would be significantly related to membership in higher comorbidity classes [14,59,60,80]. While considering age as a potential covariate, we did not have a specific hypothesis due to inconsistent evidence on the role of age for the mental health of refugee children and adolescents [75,80].

2. Methods

2.1. Population and design

This study employed a cross-sectional design involving 325 refugee adolescents residing in Nakivale refugee settlement in Southwestern Uganda. Nakivale hosts over 180,000 refugees, predominantly from Rwanda, Somalia, Burundi, and the Democratic Republic of Congo, with a majority of women and children [91]. Participants were recruited from the Base Camp zone, which was selected because it serves as the administrative and service hub of the settlement and hosts a diverse refugee population. The presence of centralized health and psychosocial services in this zone facilitated standardized clinical assessment and referral procedures.

2.2. Recruitment and sampling procedure

The target population for this study was refugee youth living in

Nakivale refugee settlement who 1) were between 10 and 19 years old, 2) had fled from their country of origin due to war, and 3) provided informed assent and parental consent. The age range of 10–19 years aligns with commonly used definitions of adolescence in research and allowed for assessment of both younger and older adolescents within the refugee settlement. Participants were selected using a systematic sampling approach from administrative lists. We obtained lists of eligible individuals from village chairpersons of 27 villages within the base camp zone. Starting from the first eligible individual on each list, we invited every third individual to participate. Using a fixed interval ensured a consistent selection procedure across villages. We approached primary caregivers of the selected adolescents to obtain parental consent, and adolescents provided informed assent. A total of 331 adolescents were selected from the lists; 325 were interviewed. Two participants did not show up at the time of the appointment while four did not meet our inclusion criteria. Data were collected and stored digitally using Kobo Toolbox. Access to the data was restricted to the lead author, who ensured data confidentiality. Data were then exported to an Excel spreadsheet for further management and analysis. For purposes of this study, only data from 269 children and adolescent refugees who met the criterion for PTSD diagnosis were included in the analysis.

2.3. Ethical considerations

This study received ethical approval from the Kenyatta National Hospital-University of Nairobi Research Ethics Committee (KNH-UON-P879/12/2023), Mbarara University of Science and Technology Research Ethics Committee (MUST-REC-MUST-2023-739) and was registered with the Uganda National Council for Science and Technology (UNCST). Administrative clearance was granted by the Office of the Prime Minister. Instruments were translated into Kinyabwisha and Kiswahili, with informed assent and parental consent obtained. Participants identified with suicidal symptoms were managed through established referral pathways. Clinical psychologists from ALIGHT and the Transcultural Psychosocial Organization (TPO) initiated referrals to Medical Teams International for immediate assessment, with onward referral to Mbarara Regional Referral Hospital when specialized or inpatient care was required.

All assessments were conducted by a clinical psychologist and a counselling psychologist who received standardized training and followed uniform assessment protocols. Interviews were conducted face-to-face in a private rented space within the Base Camp zone to ensure confidentiality and minimize distractions. Regular supervision meetings and case discussions were held to enhance consistency in interview administration and diagnostic decision-making.

The interviews took approximately 1 h and 20 min and were typically divided into two segments with a short break in between. This procedure had been reviewed and approved during the ethical clearance process. Participants received two bars of soap and one packet of salt (approximately USD 5) as compensation for their time.

2.4. Measures

Sociodemographic data, including age, education level, gender, country of origin, and migration status (accompanied or unaccompanied), were collected from participants.

Exposure to war-related traumatic events was assessed using an adapted version of a checklist of potentially traumatic events that has been applied to similar war-affected samples both within Uganda and in other contexts [2,24,65,81]. The checklist has demonstrated strong content validity and, through its consistent associations with symptom severity and diagnoses of PTSD and other mental health problems in prior research, predictive validity. The checklist included 15 items assessing exposure to various war-related traumas, such as witnessing rape by armed personnel, being tortured or abducted by armed personnel, seeing or being forced to carry dead bodies, and witnessing the death of a loved one by armed personnel. Participants were asked to respond with a "yes" or "no" to indicate whether they had personally experienced or witnessed each event. The responses were combined to a sum score of war-related trauma exposure.

Post-migration difficulties were assessed using an adapted version of the Post-migration Living Difficulties (PMLD) Checklist [87]. The 17-item scale examined the extent to which post-migration challenges posed concerns over the past 12 months. Items are rated on a 5-point scale ranging from 0 (not a problem) to 4 (very serious problem). For scoring, items rated at least 1 ("slight problem") were considered positive responses, and a total count of distinct living difficulties was calculated. The checklist thus functions as a cumulative index of discrete adversities; its items are formative rather than reflective [12], and internal consistency metrics are not applicable. It assesses difficulties such as worries about family in the home country, separation from family, fear of being sent back, difficulties with employment, loneliness, communication problems, and difficulties obtaining housing, financial assistance, or healthcare. The checklist has been used to predict psychiatric problems in both child and adult refugee samples [36,67,82].

Posttraumatic Stress Disorder (PTSD) was assessed using the International Neuropsychiatric Interview for Children and Adolescents, version 7.02 (MINI-KID), a structured diagnostic interview aligned with DSM-5, validated for psychiatric disorders across diverse populations [84]. The tool has demonstrated reliability in East African settings, including Uganda [63] and Kenya [46].

Psychiatric comorbidities. Nine disorders – Major Depressive Disorder, Panic Disorder, Agoraphobia, Generalized Anxiety Disorder, Obsessive Compulsive Disorder, Conduct Disorder, Oppositional Defiant Disorder, Attention Deficit Disorder, and Alcohol Use Disorder – were assessed using the respective diagnostic sections of the MINI-KID [84]. Internal consistency in this sample was good to excellent for both internalizing ($\alpha = 0.84–0.93$) and externalizing ($\alpha = 0.87–0.93$) spectrum disorders; full results are provided in Supplementary Table S1.

2.5. Data analyses

All analyses were conducted in R [73]. Comorbidity prevalence was first assessed, including chi-square tests for gender differences with Cramer's V effect sizes and Benjamini-Hochberg correction for multiple comparisons. This was followed by Latent Class Analysis (LCA) using the *tidy SEM* package [93], which facilitates model specification, estimation, and comparison in a user-friendly manner. Models with one to seven classes were evaluated using Bayesian Information Criterion (BIC), Akaike Information Criterion (AIC), and entropy. Model selection prioritized BIC, which favors parsimony; in cases where BIC and AIC supported different models, the model with the lower BIC was selected [68,69]. Class assignment accuracy was assessed using posterior probabilities ($\geq$0.80) and entropy. Following recommendations for stable and interpretable solutions, models with very small classes (e.g., <5% of the sample) or with fewer than five observations per parameter within a class were considered less viable due to concerns about local identifiability and replicability [93,101]. The final model was selected based on statistical fit and clinical relevance.

We examined differences between classes in terms of covariates, including gender, age, exposure to war-related traumatic events and post-migration living difficulties, using the BCH-method [11]. This approach accounts for classification errors of the model when relating external variables to latent class membership by assigning group-specific weights to cases, which provides more accurate estimates of the relationships between covariates and class membership than using the most likely class assignment. For each covariate, an omnibus likelihood ratio test was conducted to test for overall significant differences between classes. A significant omnibus test ($\alpha = 0.05$) was followed by post-hoc tests to compare specific classes, correcting for multiple comparisons using the Benjamini-Hochberg procedure.

3. Results

3.1. Psychiatric comorbidities of PTSD

In total, 82.8% ($n = 269$) of adolescents met the criteria for PTSD. Of these youth, 97.5% ($n = 262$) fulfilled criteria for at least one comorbid disorder, 76.6% ($n = 205$) for at least four comorbid disorders and 26.4% ($n = 71$) for seven or more comorbid disorders. As detailed in Table 1, girls were significantly more likely than boys to meet criteria for panic disorder, generalized anxiety disorder, obsessive-compulsive disorder, and oppositional defiant disorder, though all associations were of small magnitude.

3.2. Latent class analysis

The 3-class LCA model provided the best fit (see Table 2) and was selected as optimal. While the 4-class and 5-class models had lower AIC, our pre-specified criterion prioritized BIC, which favoured the more parsimonious 3-class model. Furthermore, the 3-class model demonstrated superior statistical stability: its smallest class ($n = 66$) provided over seven observations per estimated parameter, whereas the smallest classes in the 4-class (n = 11) and 5-class ($n = 22$) models fell below 2.5 observations per parameter, indicating a high risk of instability. The selected model had strong classification accuracy, with posterior probabilities ranging from 0.87 to 0.91 and reasonable entropy. All classes were interpretable and exceeded 20% of the sample, supporting their practical relevance.

Class 1 (24.5%, n = 66) was characterized by relatively low probabilities of all comorbid disorders (*Low-moderate comorbidity*). Class 2 (37.5%, n = 101) had high probabilities for depression and anxiety disorders but lower probabilities for other disorders (*High internalizing comorbidity*). Class 3 (37.9%, n = 102) comprised adolescents with relatively high probabilities for all comorbid disorders (*High overall comorbidity*). The classes are visualized in Fig. 1. It should be noted that some disorders, especially anxiety disorders in Class 2 and in Class 3, show conditional probabilities at or near 100%. While this indicates these disorders are highly characteristic of their respective classes in our sample, such ceiling effects should be interpreted with caution, as they may arise from the binary diagnostic assessment and the specific class composition. The descriptive statistics of the classes are displayed in Table 3.

Table 1
Comorbidity rates of PTSD in the total sample, boys and girls.

	Total (n = 269)	Boys (n = 115)	Girls (n = 154)	χ^2	Cramer's V
Major Depressive Disorder	62.8 (169)	56.5 (65)	67.5 (104)	2.96	0.11
Panic Disorder	88.9 (239)	82.6 (95)	93.5 (144)	6.83*	0.17
Agoraphobia	75.1 (202)	69.5 (80)	79.2 (122)	2.79	0.11
Generalized Anxiety Disorder	84.0 (226)	77.4 (89)	89.0 (137)	5.73*	0.16
Obsessive Compulsive Disorder	60.6 (163)	50.4 (58)	68.2 (105)	7.96*	0.18
Conduct Disorder	33.8 (91)	33.0 (38)	34.4 (53)	0.01	0.01
Oppositional Defiant Disorder	40.9 (110)	31.3 (36)	48.1 (74)	6.96*	0.17
Attention Deficit Disorder	43.9 (118)	41.7 (48)	45.5 (70)	0.23	0.04
Alcohol Use Disorder	10.8 (29)	9.6 (11)	11.7 (18)	0.13	0.03

Notes: χ^2 = Chi square; * $p < .05$ (Benjamini-Hochberg adjusted). Cramer's V effect size: 0.10 = small, 0.30 = medium, 0.50 = large.

3.3. Assessment of covariates of class membership

The results of the assessment of covariates of class membership using the BCH-method are displayed in Table 4. Omnibus tests showed that the classes differed significantly in gender, exposure to war-related traumatic events and post-migration living difficulties, but not in age (indicating no meaningful difference in mean age across classes). Post-hoc comparisons revealed that girls were significantly more likely to belong to the *High overall comorbidity* class compared to the *Low-moderate comorbidity* class and to the *High internalizing comorbidity* class. The latter two classes did not differ significantly in the composition of girls and boys. Adolescents in the *High overall comorbidity* class had significantly higher exposure to war-related traumatic events than adolescents in the *High internalizing comorbidity* class, who in turn had significantly higher exposure to war-related traumatic events than the *Low-moderate comorbidity* class. For interpretability, war trauma reflects the number of war-related traumatic event types endorsed, and the PMLD checklist reflects the number of post-migration difficulties endorsed (items rated ≥1). Given that each point on the trauma checklist represents a distinct type of severe war experience, these differences reflect a meaningful gradient in cumulative trauma burden across the comorbidity spectrum. Adolescents in the *High overall comorbidity* and in the *High internalizing comorbidity* classes reported significantly higher levels of post-migration living difficulties than the *Low-moderate comorbidity* class. As the post-migration living difficulties scale sums endorsed daily hardships, the observed difference of approximately one point indicates a tangible increase in the adversity faced by adolescents in the higher comorbidity classes, corresponding to the presence of additional stressors such as food insecurity or lack of medical care. However, the *High overall comorbidity* and *High internalizing comorbidity* classes did not differ significantly in levels of post-migration difficulties.

4. Discussion

This study identified exceptionally high rates of psychiatric comorbidity among adolescent refugees with PTSD in Nakivale, Uganda, with nearly all participants meeting criteria for at least one co-occurring disorder. Latent class analysis revealed three distinct subgroups: a low-moderate comorbidity class, a high internalizing comorbidity class, and a high overall comorbidity class. These classes differed significantly in gender distribution, with a higher proportion of girls in the high overall comorbidity class, and in exposure to both war-related trauma and post-migration stressors.

Among the most prevalent comorbid conditions were internalizing disorders (anxiety, depression, obsessive-compulsive disorder), though externalizing disorders (attention deficit disorder, oppositional defiant disorder, conduct disorder) also impacted over a third of participants. These high rates of PTSD comorbidity align with research in non-refugee populations [19,44,72,96] and adult refugees in HICs and LMICs [5,8,40,66]. However, comorbidity rates in this study were higher than in other studies of war-affected youth [16,21,89]. The high levels of trauma exposure, a known trans-diagnostic risk factor for psychopathology [58], and ongoing post-migration stressors characterizing this low-resource camp setting are plausible contextual contributors to this disparity [3]. At the same time, methodological considerations should be noted. Diagnostic interviews in contexts of high adversity may capture normative distress responses, and symptom overlap between PTSD and disorders like depression and generalized anxiety could contribute to elevated comorbidity estimates. Furthermore, the use of standardized diagnostic thresholds, while ensuring reliability, may not fully account for cultural variations in the expression and reporting of psychological distress. Differences in sampling or measurement across studies may also limit direct comparability. Alcohol use disorder, though less frequent, still affected one in ten participants, suggesting it may serve as a coping mechanism [56].

As hypothesized, LCA revealed three distinct comorbidity patterns:

Table 2
Fit and diagnostic statistics of latent class models.

Model	LL	Parameters	BIC	saBIC	AIC	Entropy	Min. prob.	Max. prob.	Min. group size (%)
1 class	−1351.64	9	2753.64	2725.10	2721.29	1.00	1.00	1.00	100
2 class	−1244.94	19	2596.17	2535.93	2527.87	0.74	0.88	0.95	34.2
3 class	**−1203.70**	**29**	**2569.65**	**2477.69**	**2465.40**	**0.75**	**0.87**	**0.91**	**24.5**
4 class	−1191.96	39	2602.11	2478.45	2461.91	0.79	0.86	1.00	4.1
5 class	−1168.22	49	2610.58	2455.22	2434.44	0.83	0.85	0.99	8.2
6 class	−1183.43	59	2696.94	2509.88	2484.86	0.91	0.70	1.00	2.6
7 class	−1161.97	69	2709.98	2491.20	2461.94	0.74	0.64	1.00	7.4

Notes: LL = Log-Likelihood, BIC = Bayesian Information Criterion, saBIC = sample-adjusted Bayesian Information Criterion, AIC = Akaike Information Criterion, Min. prob. = Minimum average posterior probability of individuals' assignment to a latent class, Max. prob. = Maximum average posterior probability of individuals' assignment to a latent class.

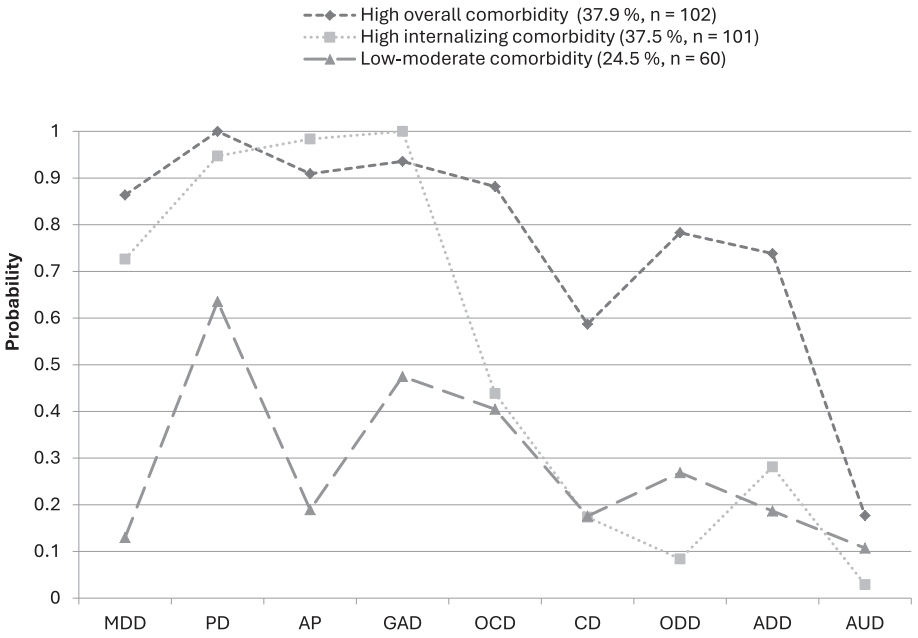


Fig. 1. Visualization of latent classes.
Notes: The y-axis displays the conditional item-response probabilities. MDD = Major Depressive Disorder, PD = Panic Disorder, AP = Agoraphobia, GAD = Generalized Anxiety Disorder, OCD = Obsessive Compulsive Disorder, CD = Conduct Disorder, ODD = Oppositional Defiant Disorder, ADD = Attention Deficit Disorder, AUD = Alcohol Use Disorder.

low-moderate comorbidity, high internalizing comorbidity (depression and anxiety), and high overall comorbidity. These patterns align with person-centered studies of Western non-refugee samples, including adults with PTSD [27,30,35,62] and adolescents without PTSD [9,25,99]. Unlike prior studies, our smallest class was low-moderate comorbidity, underscoring the severe mental health burden among refugee adolescents. It is noteworthy that even in that class comorbidity was the norm. The identification of a distinct mixed internalizing-externalizing class is also conceptually supported by variable-centered research, which demonstrates substantial correlations between internalizing and externalizing disorders in the general population [20,57]. These population-level associations suggest that the symptom domains frequently co-occur, increasing the plausibility that a subgroup of individuals with elevated liabilities to both would emerge in a person-centered analysis. This pattern is further corroborated by a recent study with South African trauma-exposed adolescents, which found PTSD to be linked to both internalizing and externalizing disorders [37]. It is possible that this mixed class is characterized by a particularly complex form of posttraumatic symptomatology as consequences of victimization and attachment trauma [28]. Although direct cross-cultural comparisons are limited by potential differences in the assessment and cultural expression of psychopathology. The absence of a purely externalizing class is consistent with studies of adolescents [25,99] and traumatized adults [30,35,62,77,88] in Western high-income countries.

We examined factors distinguishing comorbidity classes among adolescent refugees with PTSD, identifying gender, trauma exposure and post-migration stressors as key risk markers. The high overall comorbidity class had significantly more girls than boys, indicating that in this sample, adolescent girls with PTSD presented with a heightened profile of co-occurring internalizing and externalizing comorbidities. This finding should be interpreted in the context of potential gender differences in help-seeking and symptom expression, which may influence both the detection and manifestation of comorbidities, particularly in boys [76]. This pattern contrasts with studies showing higher internalizing comorbidity in females [25,42,62,100] and externalizing comorbidity in males [25,30,62], as well as the finding of greater overall comorbidity risk in male adolescents with PTSD [1]. The presentation of elevated externalizing symptoms among girls in our clinical sample therefore represents a notable finding that merits further investigation. Future research should examine whether specific factors associated with externalizing problems in girls such as trauma type [15,79], pubertal timing [18], or gendered social norms [41] help explain this pattern in contexts of severe displacement.

Trauma exposure significantly differentiated the classes, with the highest levels in the high comorbidity class and the lowest in the low-

Table 3
Descriptive statistics of latent classes in the 3-class model.

	Low-moderate comorbidity (24.5%, $n = 66$)	High internalizing comorbidity (37.5%, $n = 101$)	High overall comorbidity (37.9%, $n = 102$)
Age, *M (SD)*	15.12 (2.19)	15.15 (2.11)	15.41 (1.98)
Gender, % (n)			
Girls	45.5 (30)	54.5 (55)	67.6 (69)
Boys	54.5 (36)	45.5 (46)	32.4 (33)
Nationality, % (n)			
Congo	74.2 (49)	85.1 (86)	86.3 (88)
Burundi	10.6 (7)	11.9 (12)	11.8 (12)
Other	15.2 (10)	3.0 (3)	2.0 (2)
Orphan, % (n)	25.8 (17)	22.8 (23)	22.5 (23)
Unaccompanied, % (n)	7.6 (5)	8.9 (9)	9.8 (10)
Comorbid diagnoses, % (n)			
0–2	50.0 (33)	0.0 (0)	0.0 (0)
3	28.8 (19)	10.9 (11)	0.0 (0)
4	16.7 (11)	31.7 (32)	0.0 (0)
5	4.5 (3)	35.6 (36)	4.9 (5)
6	0.0 (0)	21.8 (22)	25.5 (26)
7 or more	0.0 (0)	0.0 (0)	69.6 (71)
Major Depressive Disorder	13.6 (9)	72.3 (73)	85.3 (87)
Panic Disorder	62.1 (41)	95.0 (96)	100 (102)
Agoraphobia	13.6 (9)	100 (101)	90.2 (92)
Generalized Anxiety Disorder	45.5 (30)	100 (101)	93.1 (95)
Obsessive Compulsive Disorder	39.4 (26)	46.5 (47)	88.2 (90)
Conduct Disorder	16.7 (11)	16.8 (17)	61.8 (63)
Oppositional Defiant Disorder	25.8 (17)	4.0 (4)	87.3 (89)
Attention Deficit Disorder	15.2 (10)	30.7 (31)	75.5 (77)
Alcohol Use Disorder	9.1 (6)	3.0 (3)	19.6 (20)
War-related traumatic events, M (SD)	8.97 (2.75)	10.02 (2.40)	11.07 (2.55)
Post-migration living difficulties, M (SD)	10.83 (2.19)	11.75 (2.20)	11.88 (2.33)

Table 4
Differences between latent classes in covariates.

Covariate	Comparison	Log-likelihood difference	*p*-value
Gender (proportion of girls)	Overall test	23.890	<0.001
	Class 1 = Class 2	2.007	0.367
	Class 1 < Class 3	21.525	<0.001[a]
	Class 2 < Class 3	11.907	0.003[a]
Age	Overall test	2.925	0.576
Exposure to war-related traumatic events	Overall test	38.285	<0.001
	Class 1 < Class 2	8.645	0.013[a]
	Class 1 < Class 3	31.814	<0.001[a]
	Class 2 < Class 3	15.154	<0.001[a]
Post-migration living difficulties	Overall test	12.439	0.014
	Class 1 < Class 2	8.086	0.018[a]
	Class 1 < Class 3	10.623	0.005[a]
	Class 2 = Class 3	0.774	0.679

Notes: Class 1 = Low-moderate comorbidity, class 2 = High internalizing comorbidity, class 3 = High overall comorbidity. Log-likelihood difference refers to the difference in log-likelihood values between nested models, used to assess the significance of differences in model fit.

[a] Significant after correction for multiple comparisons using the Benjamini-Hochberg procedure.

moderate comorbidity class. This pattern suggests a dose-response relationship between trauma load and psychiatric comorbidity, though the cross-sectional design precludes conclusions about temporal ordering or causality. It is consistent with variable-centered research linking cumulative trauma exposure to higher rates of comorbid disorders among individuals with PTSD [19,43,55]. Furthermore, it aligns with person-centered analyses in non-refugee youth [22,33,70] and adult refugees [42,60], where greater trauma exposure characterizes classes with more severe PTSD symptoms and higher levels of internalizing and externalizing problems. This body of evidence, including studies highlighting interpersonal violence as a potent risk factor [54,75,80], underscores the broad association between trauma load and mental health outcomes. Additionally, adolescents in the higher comorbidity classes reported more post-migration stressors than those in the low-moderate comorbidity class, aligning with research identifying post-displacement stressors as significant mental health risks [14,50,59,80]. Notably, the two high comorbidity classes reported similar levels of post-migration stressors, despite differing in their profiles of certain internalizing disorders (e.g., depression, obsessive-compulsive disorder) and the presence of externalizing disorders. This suggests that while ongoing adversity is a general correlate of severe comorbidity, the specific patterning of disorders—particularly the emergence of externalizing comorbidities—is linked to other factors, such as cumulative war trauma exposure. The co-occurrence of anxiety and depression in a refugee camp setting adds unique challenges to the already difficult experiences of living with PTSD.

4.1. Strengths and limitations

This study is the first to use person-centered analyses to examine PTSD comorbidity patterns and risk factors among adolescent refugees in a camp setting, a group at high risk for adversity and mental health problems. Systematic sampling from administrative lists likely reduced—but did not eliminate—selection bias, and clinical interviews ensured accurate psychiatric diagnoses and risk factor assessment. However, several limitations exist: first, the cross-sectional design prevents conclusions about the timing of comorbidities and PTSD development, and causality cannot be inferred. Second, the study focused specifically on adolescents with full PTSD diagnoses, excluding those with partial PTSD, other primary psychiatric disorders, or a non-PTSD comparison group, which may limit the generalizability and specificity of the findings and could introduce selection bias if comorbidities differ systematically between adolescents with full versus partial PTSD.

Third, while systematically sampling every third eligible person from village chairpersons' lists was the most feasible method, it may introduce selection bias if these administrative lists were not fully comprehensive or representative of all adolescent residents. Additionally, as recruitment was confined to the settlement's administrative and service hub, the findings may not fully generalize to residents of more peripheral zones or to camps with different organizational structures.

Fourth, the high prevalence and comorbidity rates, coupled with limited mental health resources in the camp, required triaging clinical referrals to participants with the most acute needs (e.g., suicidal symptoms), highlighting a gap between research identification and the provision of comprehensive care.

Fifth, our sample predominantly comprised Congolese and Burundian adolescents residing in a long-term camp setting in Uganda. Therefore, generalizability may be limited to refugees from similar

cultural backgrounds (e.g., Great Lakes Region of Africa) or to those in protracted, camp-based displacement. Cultural differences in the expression and interpretation of psychological distress—as well as in help-seeking behaviors and stigma—could affect the identification and reporting of symptoms [39,51], potentially influencing both the observed prevalence of disorders and the patterns of comorbidity.

Sixth, while the diagnostic interviews were conducted by trained, local clinical staff in participants' preferred language to enhance cultural validity, the tools themselves were developed and validated primarily in Western populations. This may affect the cross-cultural applicability of diagnostic thresholds and symptom constructs, and measurement invariance across cultural groups within our sample was not tested.

Seventh, psychometric data for the MINI-KID indicate that the reliability of youth-reported externalizing disorder diagnoses can be lower than for internalizing disorders [23]. This differential measurement precision is a relevant methodological consideration for interpreting the derived latent class structure, including the observed absence of a purely externalizing profile. Further validation of our findings in more diverse refugee groups and settings is required.

Eighth, despite the use of clinical interviews, reporting biases such as recall or social desirability bias cannot be entirely ruled out. Finally, while assessors were trained and supervised to promote diagnostic consistency, formal interrater reliability statistics were not calculated, which is a methodological limitation.

4.2. Implications for research and practice

Further research is needed to better understand psychiatric comorbidities of PTSD in adolescents, particularly high-risk groups like refugee youth. Longitudinal studies are crucial to examine the temporal relationships between PTSD and comorbidities and to identify predictors of different comorbidity trajectories, though ethical considerations must balance research with the urgency of timely treatment. Integrating comorbidity research into intervention studies is essential for advancing knowledge and practice. Future research should build on the patterns identified here such as the dose-response relationship between trauma exposure and comorbidity, and the distinct risk profile for girls to investigate the underlying transdiagnostic processes that may drive these associations [7,13]. Examining mechanisms like dysregulated fear learning, executive function deficits, or altered threat appraisal could clarify why some adolescents develop specific comorbidity profiles and inform more precisely targeted interventions [48].

The exceptionally high rates of PTSD and comorbid disorders observed demand a service delivery model that ensures continuity of care beyond research participation. This necessitates strengthening and sustaining community-based mental health systems in humanitarian settings. Our findings highlight the importance of screening for comorbid psychiatric disorders in adolescent refugees, with particular attention to the elevated co-occurring internalizing and externalizing symptoms observed among girls in this study, and addressing these conditions to create a foundation for effective trauma-focused interventions. Trauma exposure and post-migration stressors should be targeted through a multi-layered approach. Evidence-based treatments like trauma-focused cognitive behavioral therapy (TF-CBT) are supported by efficacy data from refugee youth in high-income countries [94] and by studies demonstrating its effectiveness and feasibility when culturally adapted and delivered by trained non-specialists in low-resource, conflict-affected settings [90]. However, evidence for TF-CBT in *refugee camp* settings remains limited, and its effectiveness is likely to depend on context-sensitive adaptation, supervision structures, and sustained delivery capacity. Translating these findings into successful implementation within the specific constraints of refugee camp systems will therefore require dedicated attention to workforce scalability, integration with other essential services, and further implementation research. Such interventions must be coupled with those addressing ongoing stressors such as interpersonal violence, poverty, and social isolation, which are crucial for preventing further harm [59].

5. Conclusion

This study provides novel insights into psychiatric comorbidity among adolescent refugees with PTSD in a low-resource setting, revealing high rates of comorbid disorders and distinct patterns of low-moderate, high internalizing, and high overall comorbidity. Key correlates included gender (with girls in our sample showing a pattern of heightened mixed comorbidities) and trauma exposure (which showed a positive association with comorbidity severity). Post-migration stressors were associated with both high comorbidity profiles, but did not differentiate between them. Taken together, these findings underscore the need for comprehensive screening and tailored interventions addressing both trauma and post-migration stressors to improve mental health outcomes for this vulnerable population.

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CRediT authorship contribution statement

Herbert E. Ainamani: Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Anne Wanjiru Mbwayo:** Writing – review & editing, Visualization, Validation, Supervision, Methodology, Conceptualization. **Muthoni Mathai:** Writing – review & editing, Visualization, Validation, Supervision, Conceptualization. **Jonathan Hall:** Writing – review & editing, Validation, Methodology, Conceptualization. **Godfrey Z. Rukundo:** Writing – review & editing, Validation, Investigation, Conceptualization. **Florian Scharpf:** Writing – review & editing, Writing – original draft, Formal analysis.

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Declaration of competing interest

The authors declare that they have no competing interests.

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Data availability

The data sets used and analyzed during the current study will be available on dataverse.harvard.edu upon the acceptance of the paper for publication.

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