The long-term impact of COVID-19 on mental health and the moderation effect of sex and loneliness amongst resettled refugees: findings from BNLA cohort study

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Summary

Background Vulnerability to mental health problems is well-established in refugees, attributed to the interplay between pre-and post-migration stressors. COVID-19 pandemic was recognized as a universal stressor with potential to further impact refugees' mental health. This longitudinal study sought to investigate the mental health impact of COVID-19 and its moderators in resettled refugees in Australia.

Methods Data from Waves 1 (2013–2014, pre-pandemic), 5 (2017–2018, pre-pandemic) and 6 (2023, post-pandemic) of the Building a New Life in Australia were utilized in this study. High risk of severe mental illness (HR-SMI) and post-traumatic stress disorder (PTSD) were measured by K6 and PTSD-8 scales. Using generalized linear mixed model, we examined the mental health impacts of COVID-19 pandemic and moderation effect of sex and loneliness. The difference in changes in predicted probability of HR-SMI and PTSD across Waves 1 to 5 and Waves 5 to 6 between moderator-based subgroups were calculated.

Findings A total of 2399 resettled refugees participated. The weighted prevalence of HR-SMI (Δ6-5 5.0%) or PTSD (Δ6-5 3.2%) was increased after the pandemic, different from the trend from Waves 1 to 5 (HR-SMI stable trend; PTSD decreased trend). Compared to Wave 5, Wave 6 had a significant effect on HR-SMI (AOR 1.54 [95% CI 1.17–2.04]), especially among females (2.04 [95% CI 1.16–3.56]); causing an additional 8.82% change in predicted probability than males. A significant effect of Wave 6 on PTSD was only found in respondents with loneliness (2.17 [95% CI 1.17–4.05]), causing an additional 14.92% change in predicted probability than those without loneliness.

Interpretation Rates of mental illness increased among resettled refugees in Australia from prepandemic to four years post-COVID-19 and were moderated by loneliness and being female. This highlights the need for ongoing, targeted psycho-social support for specific refugee sub-groups.

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Keywords: Refugees; Mental health; COVID-19; High risk of severe mental illness; Posttraumatic stress disorder; Loneliness; Sex

Introduction

As of May 2024, there were approximately 120 million forcibly displaced people worldwide, of whom 43.4 million were refugees, more than tripling since 2014.[1] Available evidence indicates that refugees, by virtue of their migration pathways and associated challenges,

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Research in context

Evidence before this study
Previous studies have demonstrated vulnerability to mental health problems in resettled refugees, which has been attributed to the interplay between pre-and post-migration stressors. However, it is unclear how the COVID-19 pandemic, a universal stressor, has impacted upon refugees' mental health. In August 2024, we searched PubMed for studies about the impact of the COVID-19 pandemic on refugees' mental health, using the following combination of terms: ("Refugees"[Mesh] OR "humanitarian migrant*") AND ("Mental Health"[Mesh] OR "severe mental illness" OR "post-traumatic stress disorder*") AND ("COVID-19"[Mesh] OR "SARS-CoV-2"[Mesh]). No language or date restriction was used. Previous research showed elevated rates of mental health problems (e.g., PTSD, anxiety, and depression) in the initial period of the COVID-19 pandemic and attributed the deterioration of mental health to stressors such as loneliness, worry about family, and financial hardships. Sex differences in mental health were also found during the pandemic. However, mixed findings existed because of the scarce number of longitudinal studies with representative sample, pre- and post-pandemic measures of mental health outcomes.

Added value of this study
This study adds to the limited understanding of the longitudinal mental health impacts of the COVID-19 pandemic on resettled refugees by using pre-pandemic data from Waves 1 (2013–2014) to 5 (2017–2018), and post-pandemic data from Waves 5 to 6 (2023) of the Building a New Life in Australia (BNLA) cohort. We found a post-pandemic increasing trend in refugees' mental health problems (i.e., from Wave 5 to Wave 6), which differed from the trends before the COVID-19 pandemic (i.e., from Wave 1 to Wave 5). The findings showed that sex and loneliness moderated the long-term impact of COVID-19 pandemic on refugees' mental health. Refugees that were females and reported loneliness as a stressor had an additional 8.82% and 14.92% change in predicted probability of mental health problems than males and those without loneliness respectively.

Implications of all the available evidence
Prevalence of mental health problems increased among resettled refugees in Australia from pre-pandemic to post-COVID-19 outbreak. Refugees who were female and reporting loneliness as a stressor were more vulnerable to the long-term impacts of the pandemic on mental health. This study highlights the need for ongoing, targeted psycho-social support for specific refugee subgroups.

experience higher levels of common mental disorders such as depression, anxiety and post-traumatic stress disorder (PTSD) than their host populations.[2] For example, meta-analytic data have shown that the prevalence rates of PTSD (29%), depression (30%) and anxiety (13%) are higher in refugees resettled in high-income countries relative to non-refugee populations and those living in conflict and war settings.[2]

The higher relative prevalence rate of mental illness in the refugee population can largely be attributed to the multiple, compounding stressors as well as potentially traumatic events that refugees may encounter before, during and after their migration journey. More recent research suggests that post-migration stressors (e.g., loneliness, language barriers, family separation, employment status and workforce participation, financial hardships, belongingness to the host community) which can be viewed as more proximal and psychologically salient, may play a complex role in mediating the risk of developing mental illness in the refugee population.[3–5]

The COVID-19 pandemic is an example of a universal stressor that had led to initial increases in mental health problems during the early months of the pandemic with further rises in rates of psychological distress in countries that had enforced lockdowns.[6–8] Whilst levels of mental health problems had become comparable to pre-pandemic levels after the first few months, females, individuals with pre-existing mental health conditions and COVID-19 related stressors such as financial hardships appeared to be more disproportionately affected.[9] It has been suggested that females are inherently more vulnerable to poor mental health when exposed to stress. The heightened susceptibility has been attributed to sex differences in biological factors, such as the gut microbiota–immune-brain axis, and social roles, including childcare responsibilities.[8,10] This sex-dependent susceptibility may interact with pandemic stress to impact on mental health. Notably, research has also found that loneliness, a strong correlate of mental health problems, significantly increased during the pandemic likely as a result of increased social distancing and lockdown restrictions.[8] For refugees, lockdown restrictions along with quarantine requirements have been shown to increase social isolation and may further exacerbate traumatic memories of forced isolation pre-migration along with feelings of loneliness.[11] Furthermore, research has documented that loneliness moderates the association between pre-migration stress events and the mental health of refugees, suggesting a potential susceptibility to pandemic-related stress among individuals who feel lonely.[12] Moreover, many refugees who have resettled in high-income countries often had families back in home

countries which were experiencing high infections and low vaccination rates.[13,14] Interactions with affected families in home countries may have also increased anxiety among those with prior traumatic experiences.[14]

To date research into the psychosocial impacts of the COVID-19 pandemic on refugees resettled in high-income countries has largely been restricted to cross-sectional research, which has linked COVID-19 related stressors to common mental disorders including depression, stress and PTSD.[15–17] The few available datasets from longitudinal studies have produced mixed findings due to the use of scarce explanatory variables, non-specific measures of mental health, and small sample sizes.[18–20] One longitudinal study by Shaw and colleagues included only 42 refugees resettled in the United States and found that employment and perceived safety levels decreased during the pandemic with most participants also citing concerns around health, isolation and personal finances.[18] In two longitudinal studies looking at refugees resettled in Germany using the same dataset, one found no significant changes in life satisfaction or mental health-related quality of life during the pandemic and the other reported significant negative effects of lockdown on life satisfaction.[19,20]

Given the paucity of research that has looked into the longitudinal mental health impacts of the COVID-19 pandemic on refugees resettled in high-income countries, this study uses data from Waves 1, 5 and 6 (2013–2023) of the Building a New Life in Australia (BNLA) study to explore the mental health trajectories of refugees resettling in Australia before and during the COVID-19 pandemic. This study had two main research aims: (1) to understand the mental health impacts of the COVID-19 pandemic by analyzing the trend in mental health trajectories before and after the COVID-19 pandemic and (2) to understand whether participants' sex and levels of self-reported loneliness moderated the mental health impacts of the COVID-19 pandemic. From previous research,[3,4] we hypothesized that rates of PTSD and psychological distress will have worsened following the COVID-19 pandemic and that female sex as well as those reporting loneliness will impact upon the mental health.

Methods
Study design and participants
This longitudinal study was based on the Building a New Life in Australia (BNLA), a nation-wide cohort study which aims to identify factors that promote or hinder humanitarian migrants' successful settlement and providing an evidence-base to inform program and policy development.[21] The BNLA study traced the resettlement journey of 2399 refugees who were granted permanent humanitarian visa status 3–6 months after arriving in Australia. The initial wave was conducted from October 2013 to February 2014 (Wave 1). Four

subsequent waves were conducted annually, with Wave 5 occurring between October 2017 and March 2018. Wave 6 was conducted between January to July 2023, after the COVID-19 pandemic, approximately ten years after initial resettlement.

BNLA participants were recruited from 11 different cities and consisted of principal applicants (PAs) of humanitarian visas and secondary applicants (SAs) living with PAs. Eligibility criteria for PAs included being 18 years or older and obtaining permanent humanitarian visas between May 2013 and December 2013. When eligible PAs consent to participating, SAs in the same migrant unit who were aged 15 or above were also invited to participate. Further details about the study's sampling are displayed in Fig. 1 and have been published elsewhere.[22]

This study used data from Waves 1, 5, and 6 of the BNLA cohort. Two nearby waves that include Wave 1 to 5 (with a between wave interval averaging 4.4 years) and Wave 5 to 6 (with a between wave interval averaging 5.8 years), with Waves 1 and 5 collected in pre-pandemic period and Wave 6 in post-pandemic period. This selection allowed us to capture both pre-pandemic and post-pandemic trends with similar time interval between waves and explore how mental health has evolved over time in response to the pandemic through comparison. The analytical sample included all participants who completed the questionnaire at least one of the three waves.

Procedures
Extensive consultations among government, non-government, and academic organizations, and experts on refugee settlement were conducted during the conceptualization and design stages of the BNLA study.[21] Then, at Wave 1, eligible participants were initially contacted by a letter of invitation and then recruited by telephone or home visit. Participants who had completed the Wave 1 interview and had not withdrawn from the cohort were contacted by letter to participate in Waves 5 and 6. Face-to-face interviews were conducted in all three waves, with remote interviews offered as an alternative in Wave 6. In face-to-face interviews, a computer-assisted self-interview (CASI) and computer-assisted personal interview (CAPI) were mainly used. Additionally, interviews assisted by accredited interpreters were offered as alternatives in Waves 1, 5, and 6 when CASI or CAPI was infeasible. Surveys were conducted in up to 19 languages with the assistance of interpreters in Wave 1. Fewer languages (ten and seven) were used in Wave 5 and 6, as there was a notable increase in the use of English (from 10% to 42.9%).

Measures
The main study outcomes were the presence of mental health problems, including high risk of severe mental illness (HR-SMI) and post-traumatic stress disorder
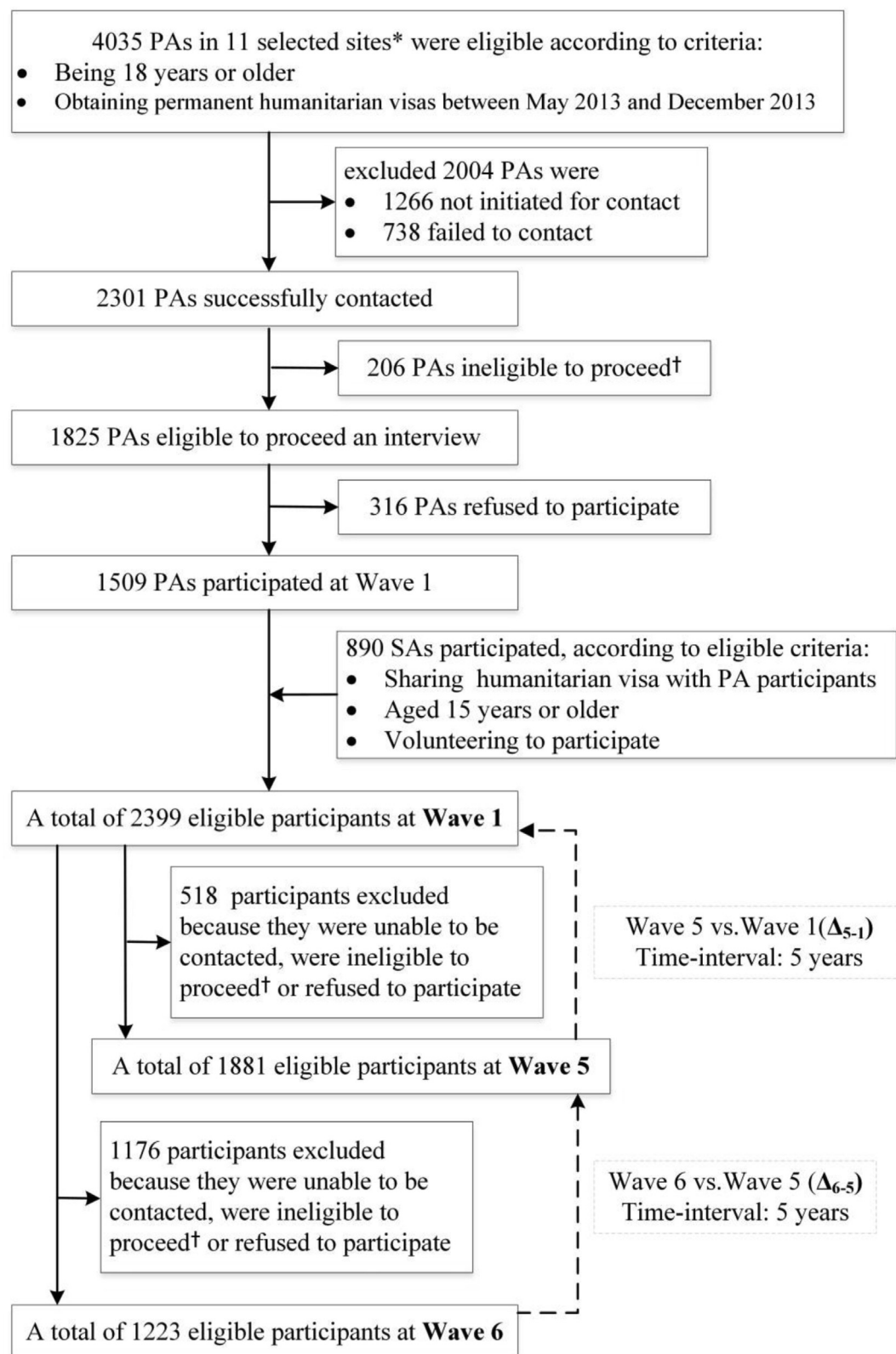
Fig. 1: Flowchart of participant recruitment and retention in the BNLA cohort. Notes: PAs: principal applicants; SAs: secondary applicants. *11 sites across Australia were selected as study settings because a large number of humanitarian migrants were set there between November 2010

(PTSD). Migration-related stressors, demographics, and other variables that impact mental health were included. The moderating roles of loneliness (as a migration-related stressor) and sex (as part of demographics) were explored.

Mental health problems

The presence of HR-SMI (yes or no) was identified by the Kessler Screening Scale for Non-specific Psychological Distress (K6). The K6 is a transdiagnostic screening tool designed to assess non-specific psychological distress rather than specific mental disorders, with six items measuring levels of reported psychological distress experienced in the last month (e.g., nervousness, hopelessness, and irritability) on a five-point scale from 1 (none of the time) to 5 (all of the time). Higher scores indicate higher levels of psychological distress. A summed score of 19 or above indicates the presence of HR-SMI.[21] The Cronbach's α of the K6 in this study was 0.89, 0.92, and 0.93 at Waves 1, 5, and 6, respectively.

The presence of PTSD (yes or no) was assessed by the PTSD-8, a standardized cross-cultural instrument validated against the Diagnostic and Statistical Manual of Mental health conditions, Fourth Edition.[23] PTSD-8 measures three core groups of PTSD symptoms (intrusion, avoidance, and hyper-arousal) in the past week. Each item was answered on a four-point Likert-type scale (1 = not at all, 4 = most of the time). If participants reported at least one item with 3 (sometimes) or 4 on all three subscales, then they are classified as having PTSD. The Cronbach's α of the PTSD-8 in this study was 0.99, 0.95, and 0.97 at Waves 1, 5, and 6, respectively.

Additionally, K6 and PTSD-8 scale were widely used and have been cross-culturally validated, demonstrating good reliability and validity, making them well-suited for the BNLA cohorts with participants from varied cultural and linguistic backgrounds.[23,24]

Migration-related variables

Migration-related variables included pre- and post-migration stressors. Participants were asked whether they had experienced any of seven pre-migration traumatic events, e.g., extreme living conditions, war or other conflict, violence, and imprisonment or kidnapping. Exposure to pre-migration trauma (yes or no) before resettlement was extracted from the Wave 1 survey.

Post-migration stressors including economic stressors (including working, housing, and financial stressor), loneliness, concerns about family in Australia

(including caring for family, family health, and family safety), and experiences of family conflict in Australia, were previously noted as important impact factors of the mental health of resettled refugees in early stage of resettlement (less than five years).[3,4] Each stressor was assessed by a single question with responses recorded as "No" (0) or "Yes" (1). The number of economic stressors and the number of family concern stressors was derived from the sum of corresponding stressors. Other post-migration stressors (e.g., loneliness) were included as dichotomized variables. Individuals were asked about these questions in all three waves used in this study.

Demographics

Demographic variables were extracted on sex (male, female), age (18–34, 35–64, ≥65 years), education (below undergraduate or tertiary degree, undergraduate and tertiary degree), marital status (single, married or co-habiting) and employment status in the past year (no, yes). Their effects on resettled refugees' mental health were extensively documented in previous studies.[2,25,26]

Other covariates

Belongingness to the Australian community (1 = always to 5 = never) and self-efficacy scores were also included as covariates as their protective effects on mental health have been documented in literature.[27] Self-efficacy scores were evaluated by three items from the General Self-Efficacy Scale.[28] Each item was rated from very true (1) to not true at all (4). A mean score was derived by averaging the responses and higher scores indicate poor self-efficacy.

Statistical analysis

The statistical analyses were done in three phases in STATA version 17. Differences in proportions or average levels of participants' characteristics were tested by chi-square tests (for categorical variables) or rank-sum tests (for continuous variables). The weighted prevalence of HR-SMI and PTSD and 95% confidence intervals (CIs) at each wave were calculated by cross-sectional weights provided in the BNLA datasets, which were adjusted for predictors of participation.[21] Differences in weighted prevalence between two nearby waves were examined by generalized linear mixed models (GLMMs), which included a fixed effect of wave term (coded as 0 and 1 to represent Waves 1 and 5 or Waves 5 and 6) and a random effect of individual adjusting for the repeated measurements.

The second phase of analysis examined the odds ratio (OR) and the 95% CIs of the pandemic and other

and October 2011. †Ineligible for proceed: successfully contacted but could not proceed with an interview for reasons, such as the participant quota for a particular site had already been met, the participant moved to an area outside the scope of interviewing, or they were unavailable for the duration of the fieldwork period.

migration-related stressors on changes in resettled refugees' mental health using hierarchical GLMMs. Model 1 was univariate which included the fixed-effect of wave or each variable above and a random effect of individual. Model 2 additionally adjusted for fixed effects of all variables considered in the study. Based on Model 2, Model 3 additionally included the interaction term between survey wave and sex, as well as wave and loneliness to test the moderation effects of sex and loneliness respectively.

We then computed marginal effects using the margins command to estimate percentage changes and 95% CIs in the predicted probability of mental health problems (i.e., HR-SMI and PTSD) within moderator-based subgroups which were tested in Model 3. This approach quantified the difference in changes between sex-based and loneliness-based subgroups while controlling for other covariates. Percentage changes in predicted probability of mental health problems were obtained by multiplying the predicted probability by 100.

Notably, cross-sectional weights were applied only for calculating weighted prevalence and not in regressions. Observations with missing outcome data were excluded from the analytical sample, while missing independent variable data were addressed using multiple imputation with the Markov Chain Monte Carlo (MCMC) approach. Accordingly, to validate the robustness of the results, a series of sensitivity analyses were conducted with weighted data (for regressions) or unweighted data (for prevalence) (Supplementary File S2), from participants who completed all three surveys (Supplementary File S3), and imputed data (Supplementary File S4).

Ethics approval

The BNLA dataset is publicly available to approved researchers (WC, AMNR, and MZ). Ethic approval for the original BNLA study was granted by the Australian Institute of Family Studies Human Research Ethics Committee. All participants were provided with voluntary written consent. Ethics exemption for using secondary data was obtained from the Western Sydney University's Human Research Ethics Committee (exemption number EX2016/01).

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

A total of 2399 resettled refugees participated in the study at Wave 1 (Table 1). At Wave 5, approximately five years since arrival, 1881 participants took part (78.4% of the Wave 1 sample). At Wave 6, around 10 years after Wave 1, 1223 respondents participated (50.9% of the Wave 1 sample and 65.0% of the Wave 5 sample).

Between 52% and 54% of the sample across Waves were males, the majority (83.9%) did not have undergraduate or tertiary education, and a larger proportion of the sample were married or co-habiting in later Waves (Wave 1: 57.4%, Wave 5: 66.1%, Wave 6: 71.7%). Over 90% of respondents reported experiences of trauma. The proportion of participants who were employed increased significantly (Wave 1: 13.7%, Wave 5: 37.4%, Wave 6: 45.4%), while the proportion of respondents with post-migration stressors decreased over time. Belongingness to host community was lowest at Wave 1 and improved over time, while self-efficacy declined over time.

The overall weighted prevalence of mental health problems across the three waves of the BNLA examined in the present study differed by mental health outcome (Table 2). For HR-SMI, while there was no significant difference between Waves 1 (16.1% [95% CI 14.5–17.8]) and 5 (15.1% [95% CI 13.4–16.9]), there was a significant increase in the prevalence of HR-SMI before (Wave 5) and after (Wave 6, 20.1% [95% CI 17.4–22.9]) the COVID pandemic. The weighted prevalence of PTSD decreased between Waves 1 (32.1% [95% CI 30.1–34.2]) and 5 (25.1% [95% CI 23.1–27.3]), but there was no significant difference between Waves 5 and 6 (28.3% [95% CI 25.4–31.5]). The largest increase in the prevalence of HR-SMI between Waves 5 and 6 was among respondents who experienced two economic stressors, those who experienced loneliness as a stressor, and those who reported family conflict. The largest increase in the prevalence of PTSD between Waves 5 and 6 was among participants who reported family conflict, those who experienced loneliness, those who reported two family concern stressors, closely followed by respondents experiencing two economic stressors.

Tables 3 and 4 show the relative importance of different risk factors for HR-SMI and PTSD after controlling for covariates. The unadjusted model (Model 1) for HR-SMI shows a significant and positive effect of Wave 6 on HR-SMI compared with Wave 5 (Table 3, UOR 1.45 [95% CI 1.14–1.83]). Once all covariates were controlled for, Wave 6 still had a significant and positive effect on HR-SMI compared with Wave 5 (AOR 1.54 [95% CI 1.17–2.04]). In Model 2, significant predictors of HR-SMI included middle age (35–64 years) compared with the youngest age group (18–34 years), female sex, higher level of education, experience of pre-migration potentially traumatic events, experience of economic stressors, loneliness, family conflict, lower sense of belonging and lower self-efficacy. Being married or co-habiting and being employed was associated with lower probability of HR-SMI. Model 3 shows a significant moderation effect of sex (Wave 6 × female, AOR 2.04 [95% CI 1.16–3.56]). The marginal effects (Fig. 2) show that there was no difference by sex in the change in predicted probability of HR-SMI between Waves 1

	Wave 1	Wave 5	Wave 6	p
Total, N	2399	1881	1223	
Age (years), n (%)				<0.001
18–34	1287 (53.6)	766 (40.7)	345 (28.2)	
35–64	1036 (43.2)	1006 (53.5)	755 (61.8)	
≥ 65	76 (3.2)	109 (5.8)	123 (10.1)	
Sex, n (%)				0.348
0 = male	1307 (54.5)	995 (52.9)	637 (52.1)	
1 = female	1092 (45.5)	886 (47.1)	585 (47.9)	
Education, n (%)				0.001
0 = below undergraduate or tertiary degree	2013 (83.9)	–	967 (79.1)	
1 = undergraduate and tertiary degree	386 (16.1)	–	256 (20.9)	
Marital status, n (%)				<0.001
0 = single	1023 (42.6)	638 (33.9)	346 (28.3)	
1 = married or co-habiting	1376 (57.4)	1243 (66.1)	877 (71.7)	
Pre-migration trauma, n (%)				0.635
0 = no	215 (9.4)	158 (8.8)	99 (8.5)	
1 = yes	2062 (90.6)	1630 (91.2)	1062 (91.5)	
Employment status, n (%)				<0.001
0 = no	1303 (86.3)	1158 (62.6)	635 (54.6)	
1 = yes	207 (13.7)	691 (37.4)	527 (45.4)	
Number of economic stressors, n (%)				<0.001
0	945 (40.9)	751 (41.7)	470 (45.3)	
1	623 (27.0)	494 (27.4)	314 (30.3)	
2	452 (19.6)	401 (22.3)	185 (17.8)	
3	288 (12.5)	154 (8.6)	69 (6.6)	
Loneliness stressor, n (%)				0.026
0 = no	1898 (82.2)	1529 (84.9)	884 (85.2)	
1 = yes	410 (17.8)	271 (15.1)	154 (14.8)	
Number of family concern stressors, n (%)				<0.001
0	1693 (73.4)	1185 (65.8)	660 (63.6)	
1	420 (18.2)	466 (25.9)	309 (29.8)	
2	195 (8.4)	149 (8.3)	69 (6.6)	
Family conflict stressor, n (%)				0.001
0 = no	2341 (97.6)	1840 (97.8)	1170 (95.7)	
1 = yes	58 (2.4)	41 (2.2)	53 (4.3)	
Belongingness score, mean (SD)	1.92 (1.06)	1.73 (0.97)	1.82 (0.99)	<0.001
Efficacy score, mean (SD)	1.66 (0.65)	1.81 (0.72)	1.85 (0.70)	<0.001

BNLA: Building a new life in Australia; SD: standardized deviation. p values were calculated by chi-square tests (for categorical variables) or rank-sum tests (for continuous variables, i.e., belongingness score and efficacy score) to test the differences in proportions or average levels among the three waves. Higher belongingness score and higher efficacy score indicate lower belongingness to Australian community and poor self-efficacy.

Table 1: Sample characteristics of the BNLA participants (N = 2399; observations = 5503).

and 5, but the change in predicted probability of HR-SMI between Waves 5 and 6 was significantly higher for females (females 9.16%; males 0.34%). There was no significant moderation effect of loneliness on the association between wave and HR-SMI.

The unadjusted (Model 1) and adjusted (Model 2) models show that PTSD was higher at Wave 1 compared with Wave 5 (UOR 1.38 [95% CI 1.18–1.62]), and there was no significant difference between Wave 5 and Wave 6 (Table 4). The adjusted model shows that middle age, female sex, higher levels of education, experience of pre-migration trauma, the presence of economic stressors, loneliness, reporting two family concern stressors (compared with none), lower belongingness to host community and lower self-efficacy were associated with PTSD over time. In contrast, being employed was associated with reduced risk of PTSD. Model 3 shows a significant moderation of loneliness (Wave 6 × loneliness, AOR 2.17 [95% CI 1.17–4.05]), illustrated in Fig. 3. Among participants reporting loneliness as a stressor, there was a large increase in the predicted probability of PTSD (15.75%) between Wave 5 and Wave 6, much

	HR-SMI, prevalence (95% CI)					PTSD, prevalence (95% CI)				
	Wave 1	Wave 5	$\Delta_{5\text{-}1}$	Wave 6	$\Delta_{6\text{-}5}$	Wave 1	Wave 5	$\Delta_{5\text{-}1}$	Wave 6	$\Delta_{6\text{-}5}$
Total	16.1 (14.5, 17.8)	15.1 (13.4, 16.9)	−1.0	20.1 (17.4, 22.9)	+5.0[b]	32.1 (30.1, 34.2)	25.1 (23.1, 27.3)	−7.0[c]	28.3 (25.4, 31.5)	+3.2
Age (years)										
18–34	12.7 (10.8, 14.9)	9.7 (7.7, 12.1)	−3.0[a]	14.2 (10.3, 19.2)	+4.5[b]	24.6 (22.1, 27.3)	18.3 (15.6, 21.3)	−6.3[b]	17.8 (13.4, 23.4)	−0.5
35–64	20.6 (18.0, 23.4)	18.7 (16.3, 21.4)	−1.9	22.4 (19.0, 26.1)	+3.7	42.0 (38.6, 45.3)	29.2 (26.2, 32.3)	−12.8[c]	31.8 (27.9, 35.9)	+2.6
≥ 65	20.8 (12.3, 32.9)	18.0 (11.2, 27.7)	−2.8	20.1 (12.6, 30.5)	+2.1	45.8 (33.6, 58.5)	34.3 (25.1, 44.9)	−11.5	34.5 (24.8, 45.6)	+0.2
Sex										
0 = male	12.5 (10.6, 14.6)	13.6 (11.5, 16.0)	+1.1	15.4 (12.3, 19.0)	+1.8	28.3 (25.7, 31.0)	23.0 (20.3, 25.9)	−5.3[b]	25.5 (21.7, 29.8)	+2.5
1 = female	20.3 (17.7, 23.0)	16.8 (14.3, 19.5)	−3.5	25.8 (21.7, 30.4)	+9.0[c]	36.6 (33.5, 39.9)	27.6 (24.6, 30.8)	−9.0[c]	31.8 (27.4, 36.6)	+4.2
Education										
0 = below undergraduate or tertiary degree	14.6 (13.0, 16.3)	14.9 (13.1, 16.8)	+0.3	19.4 (16.6, 22.6)	+4.5[b]	30.3 (28.1, 32.5)	24.6 (22.5, 26.9)	−5.7[c]	28.2 (24.9, 31.7)	+3.6
1 = undergraduate and tertiary degree	22.5 (18.1, 27.7)	16.1 (11.8, 21.5)	−6.4	22.1 (16.6, 28.8)	+6.0[a]	40.2 (34.7, 45.8)	27.5 (22.2, 33.6)	−12.7[c]	28.8 (22.5, 36.0)	+1.3
Marital status										
0 = single	15.3 (13.0, 17.9)	17.6 (14.6, 21.0)	+2.3	27.8 (22.4, 33.8)	+10.2[c]	26.1 (23.2, 29.2)	25.3 (21.8, 29.2)	−0.8	33.9 (28.0, 40.4)	+8.6[b]
1 = married or co-habiting	16.6 (14.5, 18.9)	13.9 (12.0, 16.0)	−2.7	17.2 (14.3, 20.4)	+3.3[a]	36.5 (33.7, 39.4)	25.0 (22.6, 27.7)	−11.5[c]	26.3 (23.0, 29.9)	+1.3
Pre-migration trauma										
0 = no	4.6 (2.5, 8.3)	9.9 (5.8, 16.3)	+5.3	17.9 (10.4, 28.9)	+8.0[a]	17.1 (12.0, 23.8)	12.9 (8.5, 19.2)	−4.2	20.9 (13.0, 31.9)	+8.0
1 = yes	17.9 (16.2, 19.8)	16.3 (14.5, 18.3)	−1.6	21.1 (18.3, 24.2)	+4.8[b]	34.3 (32.1, 36.6)	27.7 (25.5, 30.1)	−6.6[c]	29.6 (26.3, 33.0)	+1.9
Employment status										
0 = no	16.7 (14.6, 19.1)	19.1 (16.8, 21.6)	+2.4	28.0 (23.9, 32.6)	+8.9[c]	34.7 (31.9, 37.7)	29.7 (27.0, 32.6)	−5.0[b]	37.6 (33.0, 42.4)	+7.9[b]
1 = yes	12.7 (7.8, 19.9)	8.3 (6.3, 10.7)	−4.4	12.8 (9.8, 16.5)	+4.5	21.9 (16.2, 29.1)	17.4 (14.5, 20.7)	−4.5	20.1 (16.4, 24.5)	+2.7
Number of economic stressors										
0	7.6 (6.0, 9.5)	8.0 (6.4, 10.1)	+0.4	11.1 (8.2, 14.9)	+3.1	21.9 (19.2, 25.0)	17.4 (14.8, 20.3)	−4.5[a]	20.9 (16.9, 25.6)	+3.5
1	19.1 (15.9, 22.7)	18.0 (14.6, 22.0)	−1.1	23.0 (18.0, 28.9)	+5.0	33.5 (29.6, 37.7)	28.9 (24.8, 33.4)	−4.6	32.8 (27.0, 39.1)	+3.9
2	25.1 (20.8, 29.8)	19.8 (15.8, 24.4)	−5.3	35.6 (28.2, 43.7)	15.8[c]	43.2 (38.2, 48.3)	29.3 (24.7, 34.4)	−13.9[c]	41.2 (33.3, 49.3)	+11.9[a]
3	24.6 (19.6, 30.4)	31.1 (23.4, 39.9)	+6.5	37.1 (24.9, 51.2)	+6.0	46.1 (39.9, 52.4)	39.8 (31.5, 48.7)	−6.3	43.8 (30.9, 57.7)	+4.0
Loneliness stressor										
0 = no	13.7 (12.1, 15.5)	12.7 (11.1, 14.5)	−1.0	16.8 (14.2, 19.9)	+4.1[b]	29.5 (27.3, 31.8)	23.1 (20.9, 25.4)	−6.4[c]	26.1 (22.8, 29.7)	+3.0
1 = yes	29.4 (24.7, 34.5)	29.6 (23.9, 35.9)	+0.2	43.6 (34.9, 52.8)	+14.0[b]	46.4 (41.2, 51.7)	35.4 (29.5, 41.8)	−11.0[b]	49.8 (40.7, 58.8)	+14.4[b]
Number of family concern stressors										
0	14.6 (12.9, 16.5)	12.4 (10.6, 14.6)	−2.2	17.5 (14.5, 21.1)	+5.1[b]	28.3 (26.1, 30.7)	20.7 (18.3, 23.2)	−7.6[c]	25.5 (21.8, 29.5)	+4.8[a]
1	21.1 (17.0, 25.8)	19.2 (15.6, 23.4)	−1.9	25.6 (20.2, 31.9)	+6.4	40.2 (35.0, 45.6)	32.8 (28.3, 37.6)	−7.4[a]	33.5 (27.4, 40.1)	+0.7
2	19.9 (14.6, 26.7)	27.9 (20.6, 36.5)	+8.0	32.6 (21.9, 45.6)	+4.7	48.8 (41.2, 56.6)	40.1 (31.9, 48.8)	−8.7	53.9 (40.6, 66.7)	+13.8[a]
Family conflict stressor										
0 = no	15.1 (13.6, 16.8)	14.7 (13.0, 16.5)	−0.4	18.7 (16.1, 21.5)	+4.0[b]	31.5 (29.5, 33.7)	25.1 (23.0, 27.3)	−6.4[c]	26.8 (23.8, 30.0)	+1.7
1 = yes	53.2 (38.9, 67.0)	34.5 (20.2, 52.3)	−18.7	46.8 (32.2, 62.1)	+12.3	54.2 (40.0, 67.8)	26.1 (14.2, 43.1)	−28.1[a]	59.3 (43.4, 73.4)	+33.2[a]

Note: $\Delta_{5\text{-}1}$: changes in prevalence calculated as Prevalance$_{Wave5}$ minus Prevalance$_{Wave1}$; BNLA: Building a new life in Australia; HR-SMI: high risk of severe mental illness; PTSD: post-traumatic stress disorder; CI: confidence interval. Weighted prevalence was calculated by cross-sectional weights which provided in the BNLA datasets. Changes in prevalence between two waves were tested by subgroup generalized linear mixed models, which included a fixed effect of wave and a random effect of individuals. [a]p < 0.05. [b]p < 0.01. [c]p < 0.001.

Table 2: The weighted prevalence of mental health problems and its changes among the BNLA participants.

higher than the change in prevalence of PTSD (0.83%) among those not reporting loneliness as a stressor.

Sensitivity analyses conducted with both unweighted and weighed data revealed consistent prevalence trends, impact factors, and comparable effect estimates (Supplementary Files S2). Drop-out analyses (Supplementary Files S3) and analyses using imputed datasets (Supplementary Files S4) showed minor variations in point estimates but were qualitatively consistent with the main analyses. In summary, the sensitivity analyses demonstrated the robustness of the study's findings.

Discussion

Vulnerability towards poorer mental health outcomes in refugee populations has been well established, however our understanding of the relative significance of pre- and post-resettlement stressors is still emerging.[4,25] Despite the COVID-19 pandemic being a universal stressor,[29] there was an early recognition that vulnerable communities, such as refugee populations would be disproportionately affected due to their social and health inequities.[30] Using the BNLA longitudinal dataset, this paper reports on the trajectories of PTSD and HR-SMI in

	Model 1		Model 2		Model 3	
	UOR (95% CI)	p value	AOR (95% CI)	p value	AOR (95% CI)	p value
Wave						
Wave 5	ref	–	ref	–	ref	–
Wave 1	0.98 (0.81, 1.19)	0.871	0.87 (0.67, 1.13)	0.301	0.70 (0.48, 1.02)	0.060
Wave 6	1.45 (1.14, 1.83)	0.002	1.54 (1.17, 2.04)	0.002	0.98 (0.63, 1.53)	0.934
Age (years)						
18–34	ref	–	ref	–	ref	–
35–64	2.22 (1.79, 2.75)	<0.001	1.58 (1.21, 2.05)	0.001	1.55 (1.19, 2.02)	0.001
≥65	1.81 (1.16, 2.85)	0.010	0.80 (0.45, 1.40)	0.433	0.78 (0.44, 1.38)	0.397
Sex						
Male	ref	–	ref	–	ref	–
Female	2.09 (1.67, 2.61)	<0.001	1.43 (1.11, 1.86)	0.006	1.02 (0.72, 1.46)	0.892
Education						
Below undergraduate or tertiary degree	ref	–	ref	–	ref	–
Undergraduate and tertiary degree	1.45 (1.11, 1.90)	0.006	1.38 (1.03, 1.85)	0.031	1.37 (1.02, 1.84)	0.036
Marital status						
Single	ref	–	ref	–	ref	–
Married or co-habiting	0.80 (0.65, 0.99)	0.041	0.63 (0.49, 0.81)	<0.001	0.64 (0.49, 0.82)	0.001
Pre-migration trauma						
No	ref	–	ref	–	ref	–
Yes	2.89 (1.84, 4.54)	<0.001	1.78 (1.11, 2.88)	0.017	1.78 (1.10, 2.87)	0.019
Employment status						
No	ref	–	ref	–	ref	–
Yes	0.47 (0.36, 0.59)	<0.001	0.56 (0.42, 0.76)	<0.001	0.55 (0.40, 0.74)	<0.001
Number of economic stressors						
0	ref	–	ref	–	ref	–
1	2.58 (2.03, 3.28)	<0.001	1.98 (1.48, 2.66)	<0.001	2.01 (1.50, 2.70)	<0.001
2	3.42 (2.65, 4.40)	<0.001	2.24 (1.64, 3.06)	<0.001	2.27 (1.65, 3.11)	<0.001
3	4.44 (3.27, 6.04)	<0.001	3.31 (2.28, 4.80)	<0.001	3.39 (2.34, 4.93)	<0.001
Loneliness stressor						
No	ref	–	ref	–	ref	–
Yes	2.93 (2.34, 3.67)	<0.001	2.07 (1.57, 2.71)	<0.001	2.02 (1.32, 3.09)	0.001
Number of family concern stressors						
0	ref	–	ref	–	ref	–
1	1.66 (1.33, 2.06)	<0.001	1.07 (0.83, 1.38)	0.606	1.07 (0.83, 1.39)	0.591
2	2.28 (1.66, 3.13)	<0.001	1.14 (0.77, 1.68)	0.508	1.15 (0.78, 1.70)	0.477
Family conflict stressor						
No	ref	–	ref	–	ref	–
Yes	6.41 (4.02, 10.24)	<0.001	2.83 (1.67, 4.78)	<0.001	2.74 (1.62, 4.66)	<0.001
Belongingness score	1.82 (1.67, 2.00)	<0.001	1.49 (1.34, 1.67)	<0.001	1.49 (1.33, 1.67)	<0.001
Efficacy score	3.37 (2.92, 3.90)	<0.001	2.34 (1.97, 2.77)	<0.001	2.35 (1.98, 2.79)	<0.001
Wave 1 × Sex (female)	–	–	–	–	1.72 (1.04, 2.85)	0.036
Wave 6 × Sex (female)	–	–	–	–	2.04 (1.16, 3.56)	0.013
Wave 1 × Loneliness stressor	–	–	–	–	0.88 (0.48, 1.59)	0.668
Wave 6 × Loneliness stressor	–	–	–	–	1.35 (0.67, 2.70)	0.403

HR-SMI: high risk of severe mental illness; UOR: unadjusted odds ratio; AOR: adjusted odds ratio; CI: confidence interval; ref: reference group; –: not applicable. Generalized linear mixed models were applied. Model 1 was only adjusted for the repeated measurements of individuals; Model 2 was adjusted for all covariables above; Model 3 was adjusted for all covariables above and interactions (Wave × Sex, Wave × Loneliness).

Table 3: The impact factors of HR-SMI among resettled refugees in long-term resettlement.

a large sample of resettled refugees using multiple data collection waves pre- and post- COVID-19. We examined the impact of the pandemic on the mental health outcomes and covariates in refugees, approximately four years following the first reported case of COVID-19 in Australia, thus making our study one of the first to offer these insights outside of the pandemic's acute time frame.

	Model 1		Model 2		Model 3	
	UOR (95% CI)	p value	AOR (95% CI)	p value	AOR (95% CI)	p value
Wave						
Wave 5	ref	–	ref	–	ref	–
Wave 1	1.38 (1.18, 1.62)	<0.001	1.48 (1.19, 1.83)	<0.001	1.39 (1.04, 1.85)	0.027
Wave 6	1.19 (0.97, 1.46)	0.098	1.23 (0.97, 1.56)	0.084	1.01 (0.71, 1.44)	0.954
Age (years)						
18–34	ref	–	ref	–	ref	–
35–64	2.18 (1.84, 2.58)	<0.001	1.66 (1.35, 1.78)	<0.001	1.65 (1.34, 2.04)	<0.001
≥65	2.23 (1.56, 3.18)	<0.001	1.45 (0.93, 2.43)	0.100	1.44 (0.92, 2.24)	0.109
Sex						
Male	ref	–	ref	–	ref	–
Female	1.55 (1.30, 1.86)	<0.001	1.43 (1.15, 1.77)	0.001	1.39 (1.04, 1.86)	0.026
Education						
Below undergraduate or tertiary degree	ref	–	ref	–	ref	–
Undergraduate and tertiary degree	1.40 (1.13, 1.75)	0.002	1.44 (1.13, 1.84)	0.003	1.44 (1.13, 1.84)	0.003
Marital status						
Single	ref	–	ref	–	ref	–
Married or co-habiting	1.25 (1.05, 1.48)	0.012	1.14 (0.92, 1.41)	0.230	1.15 (0.93, 1.43)	0.193
Pre-migration trauma						
No	ref	–	ref	–	ref	–
Yes	3.23 (2.26, 4.61)	<0.001	2.17 (1.47, 3.18)	<0.001	2.18 (1.48, 3.21)	<0.001
Employment status						
No	ref	–	ref	–	ref	–
Yes	0.42 (0.35, 0.52)	<0.001	0.63 (0.50, 0.80)	<0.001	0.63 (0.50, 0.80)	<0.001
Number of economic stressors						
0	ref	–	ref	–	ref	–
1	1.95 (1.61, 2.34)	<0.001	1.65 (1.32, 2.07)	<0.001	1.67 (1.33, 2.10)	<0.001
2	2.35 (1.92, 2.89)	<0.001	1.57 (1.23, 2.02)	<0.001	1.57 (1.22, 2.02)	<0.001
3	3.52 (2.72, 4.56)	<0.001	2.34 (1.72, 3.18)	<0.001	2.37 (1.74, 3.22)	<0.001
Loneliness stressor						
No	ref	–	ref	–	ref	–
Yes	2.10 (1.72, 2.57)	<0.001	1.70 (1.34, 2.15)	<0.001	1.29 (0.89, 1.87)	0.180
Number of family concern stressors						
0	ref	–	ref	–	ref	–
1	1.65 (1.38, 1.99)	<0.001	1.16 (0.94, 1.44)	0.175	1.15 (0.93, 1.43)	0.194
2	2.75 (2.10, 3.61)	<0.001	1.58 (1.15, 2.18)	0.005	1.60 (1.16, 2.21)	0.005
Family conflict stressor						
No	ref	–	ref	–	ref	–
Yes	2.25 (1.47, 3.45)	<0.001	1.28 (0.78, 2.11)	0.327	1.26 (0.76, 2.08)	0.363
Belongingness score	1.41 (1.31, 1.52)	<0.001	1.14 (1.04, 1.26)	0.005	1.15 (1.04, 1.26)	0.005
Efficacy score	2.19 (1.95, 2.45)	<0.001	1.89 (1.64, 2.18)	<0.001	1.88 (1.63, 2.17)	<0.001
Wave 1 × Sex (female)	–	–	–	–	1.02 (0.68, 1.53)	0.926
Wave 6 × Sex (female)	–	–	–	–	1.11 (0.70, 1.77)	0.664
Wave 1 × Loneliness stressor	–	–	–	–	1.34 (0.81, 2.22)	0.256
Wave 6 × Loneliness stressor	–	–	–	–	2.17 (1.17, 4.05)	0.014

PTSD: post-traumatic stress disorder; UOR: unadjusted odds ratio; AOR: adjusted odds ratio; CI: confidence interval; ref: reference group; –: not applicable. Generalized linear mixed models were applied. Model 1 was only adjusted for the repeated measurements of individuals; Model 2 was adjusted for all covariables above; Model 3 was adjusted for all covariables above and interactions (Wave × Sex, Wave × Loneliness).

Table 4: **The impact factors of PTSD among resettled refugees in long-term resettlement.**

Very broadly, our findings indicated that while the weighted prevalence of HR-SMI did not differ between Wave 1 (2013–2014) and Wave 5 (2017–2018), there was a significant increase between Wave 5 and Wave 6 (2023), reflecting pre- and post-pandemic timepoints. It is worth noting that the intervals between the pre- and post-pandemic waves varied slightly, with approximately 4.4 years between Waves 1 and 5 and 5.8 years between
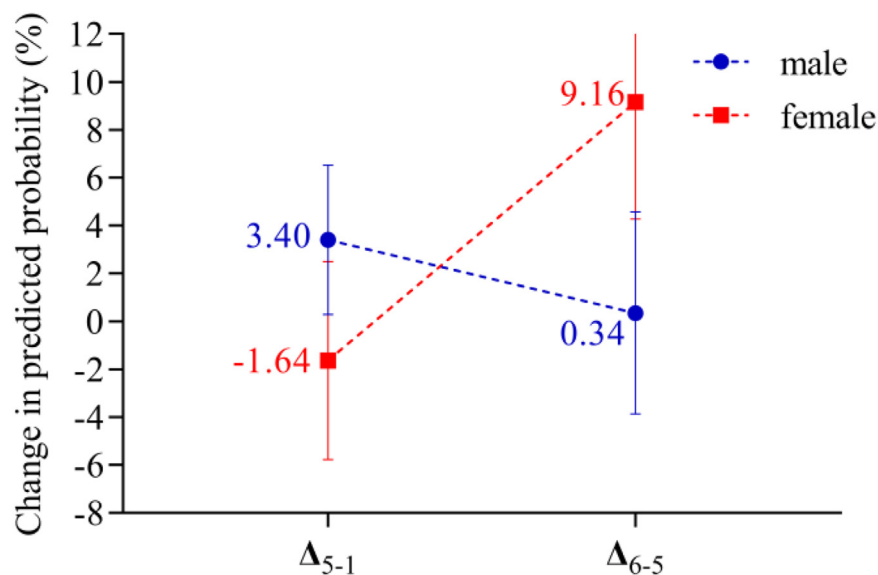
Fig. 2: The percentage change in HR-SMI predicted probability in sex-based subgroups. HR-SMI: high risk of severe mental illness. Δ_{5-1}: changes in probability calculated as Probability$_{wave5}$ minus Probability$_{wave1}$. Δ_{6-5}: changes in probability calculated as Probability$_{wave6}$ minus Probability$_{wave5}$.

Waves 5 and 6. We believe that the relatively minor differences have a limited effect on the findings. Most concerning was the increase in weighted prevalence rates of PTSD between Wave 5 and Wave 6, despite initially demonstrating a significant decrease from Wave 1 to Wave 5. Fear related to the virus itself and the possibility of dying have been found to be associated with pathological anxiety possibly further fueling a heightened fear response which has been implicated in PTSD.[16,17] This finding may also be related to Australia's

COVID-19 containment measures. For example, the potential that increased police and military presence, often enforcing lockdowns in areas with large resettled refugee communities, would be perceived as a threat and thus re-triggering, rather than seen as a protective measure, cannot be discounted given their past trauma experiences.[30] It should be noted that while other studies have demonstrated elevated rates of mental illness post COVID-19 in resettled refugee groups,[15–17,30] to date these findings related to data from the initial first to
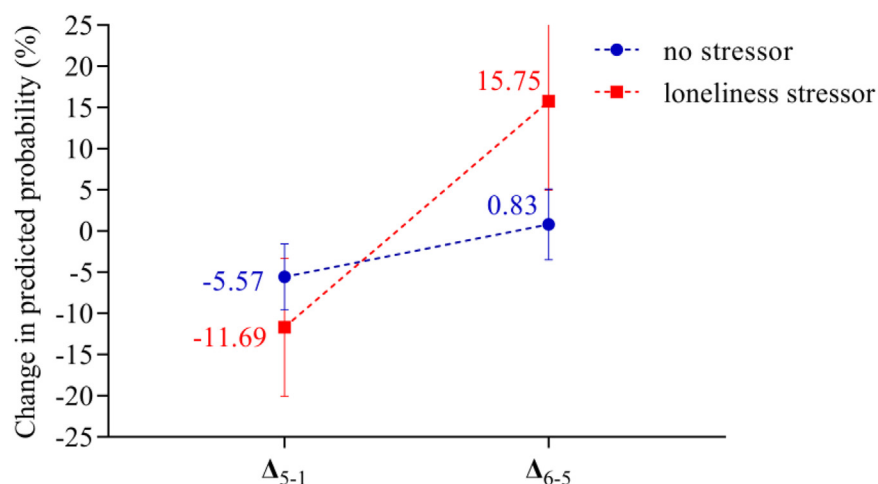

Fig. 3: The percentage change in PTSD predicted probability in loneliness-based subgroups. PTSD: post-traumatic stress disorder. Δ_{5-1}: changes in probability calculated as Probability$_{wave5}$ minus Probability$_{wave1}$. Δ_{6-5}: changes in probability calculated as Probability$_{wave6}$ minus Probability$_{wave5}$.

second year following the arrival of pandemic, making our findings even more clinically significant.

Our results also highlighted the importance of economic hardship, lower perceived self-efficacy and feelings of belonging to host community, being mid to older in age, loneliness and being female as significant predictors of both HR-SMI and PTSD at Wave 6. Beyond the trauma-informed psychological rehabilitation and care provided by organizations that comprise the Forum of Australian Services for Survivors of Torture and Trauma (FASSTT) to those with clear psychological vulnerabilities, our findings call for the development of programs to foster social connectedness while recognizing that gender sensitive approaches may be necessary for some refugee communities. For example, culturally safe public spaces where women and children can exercise, socially connect and play requires the support of policy makers and governments. Moreover, it should be recognized that pathways to recovery may also encompass helping affected refugees build on their strengths such as supporting ethnic specific community organizations which not only foster social connectedness to reduce loneliness, but can assist in harness inherent skills to advance their economic resilience. Conversely, being employed was significantly associated with reduced risk of both outcomes, and being married was associated with reduced risk of PTSD, underscoring the importance of economic security and support systems, both which have previously been noted to play a protective role.[14,20]

When examining the moderation effect of sex and loneliness on the change in prevalence of HR-SMI and PTSD between waves, some interesting patterns emerge. Females were significantly more likely to experience increases in rates of HR-SMI following the pandemic (Wave 5 compared Wave 6) and those experiencing loneliness had significantly higher rates of PTSD at Wave 6 compared to Wave 5. These findings build upon our previous research noting the significance of gender and loneliness on measures of mental health in the pre-pandemic waves of the BNLA,[3,4,25] and more recently studies of post-pandemic declines of mental health in general populations during the early stages of the pandemic.[29,31] Nonetheless, given that they were only found to moderate the changes between Waves 5 and 6, time specific factors warrant further attention. For example, considering the increasing evidence that loneliness and social isolation can exacerbate PTSD symptoms,[11] the impact of Australia's multiple lockdowns which included the closure of schools, religious institutions, and other key support systems for refugees on the elevated rates of PTSD cannot be overlooked. Further, the finding that females had significantly increased rates of HR-SMI between Waves 5 and 6 may be related to experiencing a disproportional burden associated with the prolonged lockdowns, carer responsibilities and managing the transition to remote schooling.

This study had several limitations of note. Firstly, although we were able to examine mental health outcomes across the time points including pre- and post-pandemic, no COVID-19 specific questions were included in the survey at Wave 6, preventing further analyses of the mechanisms through which COVID-19 may impact mental health. Secondly, the findings are subject to limitations inherent in the measurement tools. Although the scales used to assess HR-SMI and PTSD are well validated symptom measures that can provide probable rates of mental illness in refugee populations, they are not diagnostic tools. Loneliness was measured by a single self-reported item, which may reduce measurement reliability. Relatedly, participant's responses may have been affected by recall bias and socially desirability. Due to the nature of the BNLA design, we could not use other analytic approaches which could minimize the risk for unobserved confounding, such as regression discontinuity design or interrupted time series design, to generate the association between the COVID-19 and the change in the mental health outcomes of refugees. Despite these limitations, the study's strengths include its longitudinal, population-representative design with a community sample of resettled refugees. It assessed a wide range of variables and measured outcomes four years after the pandemic's onset, providing a clearer understanding of the long-term impact of COVID-19 on refugee mental health trajectories.

Conclusion

In conclusion, our study provided evidence that prevalence of mental illness such as HR-SMI and PTSD, increase across the period between pre-pandemic and four years following the arrival of the first COVID-19 case in resettled refugees in Australia. Given that these increases were moderated by loneliness and female sex and that Wave 6 was assessing respondents ten years after the commencement of the BNLA study, our findings underscore the need for continued and targeted psychosocial programs for specific subgroups of refugees.

Contributors
MZ, SSY, AMNR, and WC were responsible for the concept and design of this study. MZ, AMNR, and WC conducted the data analysis. SSY, TPN, PR, and AMNR prepared the initial draft. All authors contributed to the data interpretation and review, editing and revisions. WC and MZ had access to the data. WC was responsible for funding acquisition. WC and AMNR had final responsibility for the decision to submit for publication.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lanwpc.2025.101516.

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