

Research Article

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Impact of a music therapy program on mental health and school attendance among female adolescents in Kasai-Central province, Democratic Republic of Congo

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Abstract

This study assessed whether a music therapy program improved mental health and school attendance among girls in the Democratic Republic of Congo (DRC) following economic and conflict-related insecurity. It included 483 girls aged 10–14 who participated in the Healing in Harmony (HiH) program, implemented by World Vision and Make Music Matter in Kasai-Central province. Participants completed surveys before and after the program, and up to two follow-up interviews assessing depression, anxiety, self-esteem, and school attendance. Before the program, 36.0% (95% CI 31.7%–40.3%) and 60.5% (95% CI 56.1%–64.8%) screened positive for depression and anxiety, respectively. After participation, the risk of screening positive declined by 75% for depression (RR = 0.27, 95% CI 0.22–0.32) and by about half for anxiety (RR = 0.46, 95% CI 0.41–0.53), with improvements sustained up to 17 months. Self-esteem scores increased by 3.93 points (95% CI 3.22–4.64, $p < 0.001$). School absenteeism decreased from 10% (95% CI 7.2%–12.6%) to 5.4% (RR = 0.54, 95% CI 0.40–0.73). Participation in HiH was associated with sustained improvements in mental health and school attendance. These findings support integrating psychosocial care into humanitarian responses to improve both mental health and educational outcomes for crisis-affected children.

Impact statement

This study advances the global understanding of effective interventions to improve mental health among children in conflict settings. Exploring the impact of Healing in Harmony (HiH), a music therapy program, on mental health outcomes as well as school attendance provides critical insights into addressing the unique needs of trauma-affected children exposed to conflict in low- and middle-income country contexts. This article contributed to the evidence base for effective programming in these vulnerable populations. The study was carried out in the Kasai-Central province in the Democratic Republic of Congo among 10- to 14-year-old girls. We found that participating in the HiH program was associated with significant improvement in the children's mental health. Moreover, these positive benefits were observed to last up to 17 months after girls complete the program

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I start to walk alone
The desire for suicide crosses my mind
In the group with whom I now sing
I have been encouraged, and I am moving forward.
(Dinanga Enfants Solidaires, 2022, Ndi Muana Mubanda Mupongo)

Introduction

An estimated 142 million children live in conflict areas, 24 million of whom will require mental health support because of the trauma they experience (Cowley et al., 2019). This is the reality for hundreds of thousands of children in Kasai-Central province of the Democratic Republic of Congo (DRC). Following the civil wars in 1996–1997 and 1998–2003, several provinces in the eastern DRC continued to experience economic and conflict-related instability (Warren, 2011), with their populations suffering from conflict-associated trauma (Campbell et al., 2009; Chen et al., 2010; Dossa et al., 2014; Ba & Bhopal, 2017). Additional conflicts in 2016 and 2017 within Kasai-Central province caused more than 3,300 deaths, 1.4 million internally displaced persons and the destruction of over 400 schools (UN Human Rights Council, 2018). Children within the area had their school disrupted for up to 2 years (UNICEF, 2017), the challenges of which were compounded by the coronavirus disease 2019 (COVID-19) pandemic. Providing evidence-



based psychological services to children and adolescents to reduce the mental health consequences of trauma in the context of ongoing humanitarian crises is critical to healing trauma and improving resiliency (Ceccarelli et al., 2024; Bangpan et al., 2024; Purgato et al., 2018; Murray et al., 2018; Bass et al., 2013).

While data on the effectiveness of mental health interventions in humanitarian crises is limited (Kamali et al., 2020), emerging evidence supports their value in low- and middle-income countries (LMICs) (Ceccarelli et al., 2024; Alokkan-Sever et al., 2023; Uppendahl et al., 2020; Bangpan et al., 2024; Purgato et al., 2018; Morina et al., 2017). Two recent meta-analyses focused on adults. One found that psychotherapy reduced post-traumatic stress disorder (PTSD) and depression in survivors of mass violence (Morina et al., 2017), while the other showed that mental health services reduced PTSD and improved functioning in adults affected by humanitarian crises in LMICs (Bangpan et al., 2019).

Three recent meta-analyses have included studies that enrolled children and adolescents. One meta-analysis (seven studies, $n = 130$) found PTSD improved posttreatment, but the effect was not sustained at 4 months (Purgato et al., 2018). In contrast, a larger meta-analysis (13 studies, $n = 2,626$) of psychological interventions in LMICs found cognitive behavioral therapy and group-based approaches effectively reduced PTSD, depression and anxiety (Uppendahl et al., 2020; Alokkan-Sever et al., 2023). A third meta-analysis of 43 randomized clinical trials also reported that cognitive behavioral therapy improved depression symptoms in children and adolescents affected by humanitarian emergencies (Bangpan et al., 2024). Another review highlighted that most studies focused on program implementation rather than the impact on mental health outcomes (Ceccarelli et al., 2024).

The relationship between mental health and schooling in LMICs is increasingly recognized (Aston et al., 2023). Schools, which play a crucial role in providing health education and services where healthcare systems are lacking (Sawyer et al., 2021), are exploring how school-based interventions can enhance mental health and well-being (Grande et al., 2023; Partap et al., 2023). Despite limited research on the impact of mental health interventions on school attendance, two recent meta-analyses have highlighted the link between anxiety and absenteeism or truancy (Finning et al., 2019; Dalforno et al., 2022).

Emerging evidence suggests that music therapy that is coupled with lyrical music training can be effective in reducing anxiety, depression and PTSD (Erkkilä et al., 2011; Carr et al., 2012; Carr et al., 2013; Aalbers et al., 2017; Landis-Shack et al., 2017). As music has been shown to stimulate brain areas related to traumatic memory and sensory-emotional processing (Koelsch, 2009),

Table 2. Data collection schedule

Cohort	Program pretest Time 0	Program posttest Time +1	Follow-up (October 2022) Time +2	Follow-up (January 2023) Time +3
#1	April 2021	August 2021	13.5 months post program	17 months post program
#2	October 2021	December 2021	9.5 months post program	13 months post program
#3	April 2022	June 2022	3.5 months post program	7 months post program
#4	August 2022	October 2022	N/A	3.5 months post program
#5	November 2022	January 2023	N/A	N/A

research suggested that music can facilitate the accessing and processing of severe past trauma (Johnson, 1987; Bensimon et al., 2022; Carr et al., 2012), especially given the photographic versus linguistic nature of traumatic memories (Johnson, 1987; Bensimon et al., 2022). Thus, the symbols and metaphors present in music and lyric writing can help survivors verbalize and process trauma. McFerran et al. proposed that musical therapy approaches can be organized into four categories – stabilizing, entrainment, expressive and performative (McFerran et al., 2020). Performative approaches recognize the societal context of trauma, enabling the survivor's identities to be reconstructed and 'brought to life' through song and public musical performance.

Healing in Harmony (HiH) is an innovative music therapy program (Make Music Matter, 2020) centered around a locally built professional recording studio designed to provide therapy to trauma survivors. Working with a trained therapist and professional music producer, participants engage in therapy and develop their musical artistry, approaching the healing process by writing, recording and professionally producing songs about their emotions and experiences. As described elsewhere (Cikuru et al., 2021), this therapeutic approach – rooted in cognitive behavioral therapy (Rothbaum et al., 2000) – uses group sessions and lyrical music to help participants articulate their trauma and begin the cognitive and evaluative stages of health, much like a producer composing an instrumental track to support an unfolding narrative. The goal is for participants to emerge as confident artists and advocates.

In a prior evaluation of the HiH program, the mental health of women living in an insecure rural area who had suffered conflict-related trauma and/or conflict-related sexual violence was also

Table 1. HiH cohort enrollment, completion, study sampling and attrition (10- to 14-year-old females only)

Cohort #	District 1				District 2			
	Enrolled in HiH	Completed HiH	Data collection October 2022	Data collection January 2023	Enrolled in HiH	Completed HiH	Data collection October 2022	Data collection January 2023
1	92	49	17	12	105	103	51	50
2	58	48	19	16	23	13	7	7
3	182	152	56	55	158	132	62	64
4	43	41	22	19	199	165	94	82
5	190	178	62	53	164	137	127	125
Total	565	468	166	155	649	550	341	328

observed to improve following their participation in the HiH program (Cikuru et al., 2021). The proportion screening positive for anxiety, depression and PTSD declined by 40%, 50% and 50%, respectively, with results sustained through 6 months of follow-up. In addition, self-perceived stigma, feelings of unworthiness and unhappiness declined, while reporting a sense of happiness and feeling proud of and liking oneself increased substantially.

World Vision engaged Make Music Matter (MMM) to implement HiH as a component of their programming in the DRC, including in the Equality for Girls Access to Learning (EGAL) project, an inclusive, gender-transformative initiative designed to enhance girls' agency, resilience in fragile contexts and independent decision-making. The project sought to enhance girls' agency, increase their resilience in fragile contexts, create education opportunities and improve their power for independent decision-making. Within that framework, the HiH program aimed to reduce barriers, specifically psychosocial stress, that prevent girls from accessing education.

This study aimed to assess whether participation in HiH was associated with a decrease in symptoms of depression or anxiety, or an increase in self-esteem in children who experienced trauma because of the prolonged violent conflict in the area. In addition, the study examined how school attendance changed over the life of the program and whether shifts in school attendance were correlated with depression, anxiety or self-esteem.

Methods

This study utilized a pre-post design with longitudinal follow-up (Shadish et al., 2002) to assess an HiH program rolled out as part of a World Vision education project, which aimed to reduce barriers to education for girls, aligned to the objectives of Global Affairs Canada's G7 Charlevoix funding for girls' education in fragile contexts. The project was implemented in two districts in the Kasai-Central province (hereafter referred to as District 1 and District 2), which are areas of ongoing conflict, violence and instability. The study included the catchment areas of 22 primary and 2 secondary schools participating in the World Vision project.

The HiH program

The HiH program was implemented by the MMM program team for community members located within World Vision programming sites. The program was overseen by a qualified psychologist and technical lead based in Bukavu. In each district, the MMM program team recruited a psychologist and a music producer to run the HiH sessions and facilitate the songwriting and production. World Vision assisted HiH program staff with logistics and acted as a bridge between the community and the program, often liaising with local schools. The therapeutic approach is more fully described elsewhere and summarized in [Supplementary Table S1](#) (Cikuru et al., 2021).

HiH program participants were identified after a large-scale community sensitization initiative that reached diverse members of the target community, including school authorities, parent committees, students and parents within the school communities. However, the EGAL program targeted girls and participation in the HiH program was designed to be inclusive of the broader community based on community input. Project staff identified 1,392 program participants from District 1 and 1,275 from District

2 through this process. Five cohorts of participants per district were enrolled in the HiH program between April 2021 and January 2023. Each cohort included 200–300 participants, a mix of both boy and girl children, as well as adult women. For facilitation, participants were organized into groups of 25–30, who participated in the therapy program together. The first cohort participated in HiH programming over 5 months, with one session held per week. Cohorts 2–5 took part in the usual program cycle of 12 weeks per cohort, with sessions held twice per week, followed by a period of performing and sharing their music with the community. Overall, the HiH program had a completion rate of 74.7%, with a higher completion rate in District 2 (83.9%) than in District 1 (70.9%). Completion rates differed by age category. Only 49.1% of those over 18 years completed the program, compared with completion rates of 86.4% for children under 9 years, 83.8% for children 10–14 years of age and 67.7% for 15- to 17-year-olds.

Data collection

Two research teams gathered data to use for this analysis. The first team consisted of two HiH program staff, and the local psychologists ran the intervention programming and collected pretest and posttest for all program participants. MMM carried out programmatic and data collection training for this first team over a period of 5 days. HiH program staff were trained to complete the pre- and post-assessments for all program participants, completing pre- and post-interviews for the first three cohorts and pre-interviews for the fourth cohort.

Subsequently, a second team, Informed International (hereafter referred to as Informed), was hired by World Vision to carry out an independent evaluation of the HiH component of World Vision's EGAL project, which, as noted above, focused on enhancing girl's agency. Thus, this component of the data collection focused on girls aged 10–14 years. Informed employed enumerators identified by the University of Kananga Kasai's Dean of Social Sciences Psychology as strong fourth-year students and graduate assistants. Over 6 days, Informed trained 20 enumerators, 16 of whom were hired for data collection. Informed undertook data collection in October 2022 and January 2023. For a random sample of 10- to 14-year-old girls, Informed conducted the post-interview and a 4-month follow-up interview for Cohort 4 and the pre- and post-interviews for Cohort 5. During each data collection period, Informed also collected follow-up interviews with a random sample of 10- to 14-year-old girls in Cohort 13 at 4, 10 and 14 months and at 8, 14 and 18 months, respectively. Follow-up interviews included a caregiver survey of one caregiver for each study participant.

Study participants

This research focused on girls because this study was funded as part of the World Vision's EGAL project. The EGAL project aimed to develop effective strategies to help girls in the DRC cope with trauma from gender-based violence, reduce anxiety, depression and PTSD, and improve school attendance. The evaluation was limited to the 10- to 14-year age group as funding was limited, and only this age group was well-represented across all five rounds of the HiH program implementation.

As described in [Table 1](#), a total of 1,214 school-going girls aged 10–14 years old were enrolled in the HiH program. The pre-post evaluation reported here focused on a subsample of the 1,018 (83.8% of the 1,214) girls aged 10–14 years, who completed the HiH program. Study participants were identified by random

sample and stratified by cohort and district. Of the 507 enrolled, the study team observed a 4.7% loss to follow-up between data collection periods and completed the study with 483 girls 10–14 years of age.

We utilized data collected by the HiH staff for the pre- and post-assessments for eligible study participants in Cohorts 1–3 and the pre-assessment for Cohort 4, and data collected by Informed’s study team for the post-assessment for Cohort 4 in October 2022 and the pre- and post-assessments for Cohort 5 in October 2022 and January 2023, respectively. The two follow-up interviews with sampled participants in Cohorts 1–3 were collected during the October and January data collection periods, and the one follow-up interview for Cohort 4 during the January data collection period is described in Figure 1.

The study was approved by the Ethics Committee Republique Democratique du Congo–Comité National d’Ethique de la Sante (CNES), CNES 001/DPSK/1922.2022. Consent was obtained from each child’s parent or guardian, and assent was obtained from each girl child for each interview. Child interviews were carried out at the schools, while caregiver interviews were conducted at the World Vision HiH program facilities in French and Tshiluba.

Measures

Each cohort was administered a mental health screening shortly before (pretest/Time 0) and immediately after completing (posttest/Time + 1) their HiH program. The interval between the pretest (Time 0) and the posttest (Time +1) is the same for all cohorts except for Cohort 1 due to the constraints of the COVID-19 pandemic. Follow-up interviews were conducted 3.5–17 months posttreatment (see Table 2). In addition to assessing mental health, interviews obtained information on demographic characteristics, risk factors and school participation.

Mental health assessment

Measures included the Birlson Depression Self-Rating Scale for Children (Birlson et al., 1987), the Hopkins Symptom Checklist (HSCL) (Parloff et al., 1954) to assess anxiety and the Rosenberg Self-Esteem Scale (Rosenberg, 1965). This depression scale has been applied across diverse cultural settings, including among children in Afghanistan and Nepal (Panter-Brick et al., 2009; Kohrt et al., 2011). The HSCL has been used extensively in high-conflict, cross-cultural contexts to assess mental health symptoms (Tay et al., 2017), including in a study among adolescents in conflict-affected regions of Eastern DRC (Mels et al., 2010). Similarly, the Self-Esteem Scale is a well-established measure for assessing adolescents, most notably in a study among adolescent refugee girls in Ethiopia (Stark et al., 2018). To ensure the cultural

appropriateness of these measures, we undertook a translation and adaptation process, including forward and backward translation by bilingual experts, reconciliation of discrepancies and pilot interviews with a sample of participants to assess comprehension and cultural relevance.

The 18-item Birlson was asked of each child, with children responding for each item whether it was experienced most of the time (2), sometimes (1) or never (0) over the last week. The responses were summed, and students scoring at or above 18 were classified as screening positive for depression, as validated in a similar context among children in Burundi (Ventevogel et al., 2014). For anxiety, children were asked to indicate the frequency they had experienced each of a 10-item inventory of anxiety symptoms in the HSCL, including not at all (0), a little (1), quite a bit (3) and extremely (4) in the last month. The responses were summed across all items, and a mean score was calculated. Children were classified as screening positive for anxiety if their mean score was ≥1.85 (Strand et al., 2003). The Self-Esteem Scale is a 10-item inventory, with each question using a 1- to 4-point Likert scale. Scores were summed such that higher values indicate higher levels of self-esteem, ranging from 10 to 40.

School participation

Information on a child’s enrollment status and attendance at school over the last 4 weeks was gathered from both the child respondent and caregiver, as well as from the school records. Absenteeism rates were determined by examining school attendance records for the 4 weeks preceding data collection. Schools were open between 20 and 26 days in the 4 weeks before data collection, depending on the school. Data from school records on enrolment and attendance were used in the primary analyses and supplemented by the child and caregiver survey data regarding reasons for school absence.

Demographic characteristics and risk factors

Demographic characteristics included age, although it should be noted that age is often not precisely known, such as grade in school, socioeconomic status (SES) and disability status. Both age and grade were gathered by child self-report, and grade level was considered more reliable than age data. To determine SES, children were asked whether their household owned any of the 12 possessions, such as a radio, mobile phone, electricity, bicycle, car or toilet (UNICEF, 2019). The number of possessions was summed, and then the summation was divided into three groups. Disability status was determined based on the Washington Group Short Set on Functioning (WG-SS), a set of six questions the girl’s caregiver asked regarding difficulties seeing, hearing, walking or climbing stairs, remembering or concentrating, self-care and

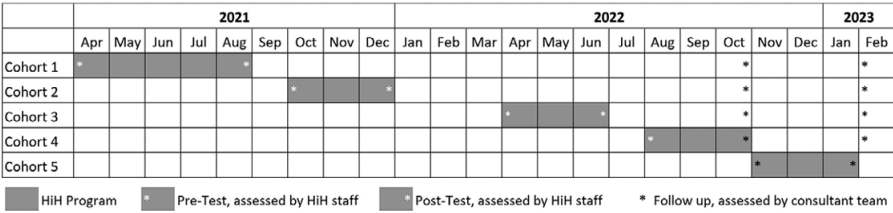


Figure 1. Illustration of the study design. The HiH program was implemented sequentially across five time periods (gray): April–August 2021, October–December 2021, April–June 2022, August–October 2022 and November 2022–January 2023, with data collection occurring at the start and end of each program (white stars), in addition to October 2022 and February 2023 (black stars).

Table 3. Demographic and education characteristics of girls enrolled in the study

	Cohort						<i>p</i> value
	Overall <i>N</i> = 483	1 <i>N</i> = 62	2 <i>N</i> = 23	3 <i>N</i> = 119	4 <i>N</i> = 101	5 <i>N</i> = 178	
District							<0.001 ^a
District 1	155 (32.09%)	12 (19.35%)	16 (69.57%)	55 (46.22%)	19 (18.81%)	53 (29.78%)	
District 2	328 (67.91%)	50 (80.65%)	7 (30.43%)	64 (53.78%)	82 (81.19%)	125 (70.22%)	
Age							<0.001 ^b
10	122 (25.26%)	23 (37.10%)	0 (0.00%)	39 (32.77%)	20 (19.80%)	40 (22.47%)	
11–12	207 (42.86%)	24 (38.71%)	8 (34.78%)	60 (50.42%)	35 (34.65%)	80 (44.94%)	
13–14	154 (31.88%)	15 (24.19%)	15 (65.22%)	20 (16.81%)	46 (45.54%)	58 (32.58%)	
Grade							<0.001 ^a
1–5	226 (46.79%)	24 (38.71%)	6 (26.09%)	51 (42.86%)	34 (33.66%)	111 (62.36%)	
6	185 (38.30%)	25 (40.32%)	4 (17.39%)	57 (47.90%)	32 (31.68%)	67 (37.64%)	
7–12	70 (14.49%)	13 (20.97%)	11 (47.82%)	11 (9.24%)	35 (34.65%)	0 (0.00%)	
Missing	2 (0.41%)	0 (0.00%)	2 (8.70%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	
Disability							0.006 ^b
No	445 (92.13%)	59 (95.16%)	21 (91.30%)	107 (89.92%)	95 (94.06%)	163 (91.57%)	
Yes	23 (4.76%)	1 (1.61%)	2 (8.70%)	0 (0.00%)	6 (5.94%)	14 (7.87%)	
Missing	15 (3.12%)	2 (3.23%)	0 (0.00%)	12 (10.08%)	0 (0.00%)	1 (0.56%)	
Socioeconomic status							0.001 ^a
Low	278 (57.56%)	39 (62.90%)	12 (52.17%)	54 (45.38%)	53 (52.48%)	120 (67.42%)	
Middle	109 (22.57%)	17 (27.42%)	7 (30.43%)	29 (24.37%)	21 (20.79%)	35 (19.66%)	
High	96 (19.88%)	6 (9.68%)	4 (17.39%)	36 (30.25%)	27 (26.73%)	23 (12.92%)	

^a χ^2 test.^bFisher's exact test.

communication (expressive and receptive). Each question has four response categories to assess the severity to which the difficulty is experienced: no difficulty, some difficulty, a lot of difficulty and it cannot be done at all (Altman, 2016). Girls were identified as disabled if at least one domain is coded as a lot of difficulty or cannot do at all.

Statistical analysis

We calculated the mean and standard deviation of each continuous variable and the frequencies for each categorical variable at each time point for each cohort.

To assess change over time, a time variable was defined in relation to the start of the therapy (0 = start of therapy, +1 = end of therapy, +2 = first follow-up and +3 = second follow-up). We calculated descriptive statistics and constructed box plots for depression, anxiety and self-esteem scores at each time point, overall and by cohort. In addition, we calculated the percentage and 95% confidence intervals (CIs) for scoring positive for depression and anxiety at each time point.

We constructed generalized estimating equation (GEE) models with unstructured covariance and a normal distribution to estimate mean differences in continuous scores. To estimate relative risks (RRs), proportions were modeled using GEE with an unstructured covariance and Poisson distribution (Zou and Donner, 2013). We summarized the HiH program effects by

collapsing time into pretest (Time 0) and posttest (Time +1, +2 or +3) periods. We adjusted all models for the design variable cohort and district, grade and SES. Observations with missing data were excluded from the regression models. As a sensitivity analysis, we also ran models for each cohort separately. Statistical significance was defined at $\alpha < 0.05$. Analyses were performed using Stata/MP 15.1.

Results

The 483 girls ranged in age from 10 to 14 years, with a median age of 12 years. Table 3 provides information on the distribution of participant characteristics overall and by cohort. Two-thirds of participants were in District 2 (67.9%). Cohort 2 tended to be older, with 65.2% of participants being 13–14 years old. Almost all (99.8%) participants were enrolled in school with a median grade of 6. Few (4.8%) of the participants screened positive for a disability, according to the WG-SS. Over half (57.6%) of the participants were in the low SES category based on possessions. Cohorts 1 and 5 had the greatest proportion of participants in the low SES category.

Mental health measures

Boxplots of the scores for anxiety, depression and self-esteem by time are provided in Figure 2. Similar boxplots by Cohort are

provided in [Supplementary Figure S2](#). At the pretest (Time 0), median scores for depression were 17; (interquartile range [IQR] = 13–20) declining to 14 (IQR = 8–18) at the posttest assessment (Time +1), while scores for anxiety were 20 (IQR = 15–25) declining to 13 (IQR = 11–17) and for self-esteem were 27 (IQR = 24–29) increasing to 30 (IQR = 28–32) over the same period. After the HiH program, median scores for depression declined more substantially to 11 (IQR = 7–14) at the first and 9 (IQR = 7–11) at the second follow-up. Anxiety fluctuated, increasing to 18 (IQR = 12–23) at the first follow-up and decreasing again to 12 (IQR = 11–15) at the second follow-up.

The proportion of girls who screened positive for depression and anxiety, as well as average self-esteem score, is presented in [Table 4](#) by time and cohort. At the pretest (Time 0), 36.0% screened positive for depression and 60.5% for anxiety; 20.1% screened positive for both conditions at the pretest time. At the posttest (Time +1), 18.0% screened positive for depression, 20.3% screened positive for anxiety and 2.9% screened positive for both conditions.

As evidenced in [Table 4](#), anxiety spiked at Time +2 for Cohorts 1–3, Time +1 for Cohort 4 and Time 0 for Cohort 5, which coincided with the food insecurity observed in October, as discussed in the methodology.

School attendance measures

According to school records, 99.8% of the girls in the research study were officially enrolled in school. Overall, for the 4 weeks before data collection, girls missed an average of 2.0 days at follow-up 1 and 1.4 days at follow-up 2, with absenteeism rates of 8.2% and 6.1%, respectively, after accounting for the number of days the school was open during that period (ranging from 20 to 26 days). Reasons for missing school were most often illness, followed by chores or lack of money. [Figure 3](#) shows that although the median absenteeism rate is relatively low, the average absenteeism rate improvement came from outliers with very high absenteeism rates at pretest. At the pretest, 21 of the 176 (11.9%) study participants in

Table 4. Proportion (and 95% CIs) of girls who screened positive for depression and anxiety, average self-esteem score by time and cohort

	Time 0	Time +1	<i>p</i> value ^a Time 0 v. +1	Time +2	Time +3
Cohort 1 (N = 62)					
Depression	12.9% (4.3–21.5)	17.7% (8.0–27.5)	0.450	0.3% (–1.3 to 7.7)	11.3% (3.2–19.4)
Anxiety	32.3% (20.3–44.2)	1.6% (–1.6 to 4.8)	<0.001	66.1% (54.0–78.2)	17.7% (8.0–27.5)
Cohort 2 (N = 23)					
Depression	30.4% (10.1–50.8)	39.1% (17.6–60.7)	0.5463	4.3% (–4.7 to 13.4)	4.3% (–4.7 to 13.4)
Anxiety	69.6% (49.2–90.0)	8.7% (–3.8 to 21.2)	<0.001	78.3% (60.0–96.5)	13.0% (–1.8 to 27.9)
Cohort 3 (N = 119)					
Depression	43.7% (34.7–52.7)	45.4% (36.3–54.5)	0.7953	5.0% (1.1–9.0)	1.7% (–0.6 to 4.0)
Anxiety	53.8% (44.7–62.9)	1.7% (–0.7 to 4.0)	<0.001	68.9% (60.5–77.3)	6.7% (2.2–11.3)
Cohort 4 (N = 101)					
Depression	68.3% (59.1–77.5)	8.9% (3.3–14.6)	<0.001	1.0% (–0.9 to 3.0)	
Anxiety	40.6% (30.9–50.3)	74.3% (65.6–82.9)	<0.001	8.9% (3.3–14.6)	
Cohort 5 (N = 178)					
Depression	21.3% (15.3–27.4)	2.2% (0.1–4.5)	<0.001		
Anxiety	84.8% (79.5–90.2)	10.1% (5.6–14.6)	<0.001		
Self-esteem	27.0 (26.4–27.5)	30.9 (30.5–31.3)	<0.001		
Overall					
Depression	36.0% (31.7–40.3)	18.0% (14.6–21.5)	<0.001	3.3% (1.3–5.3)	4.9% (1.9–7.9)
Anxiety	60.5% (56.1–64.8)	20.3% (16.7–23.9)	<0.001	49.2% (43.5–54.8)	10.8% (6.5–15.1)

^aMcNemar's χ^2 test.

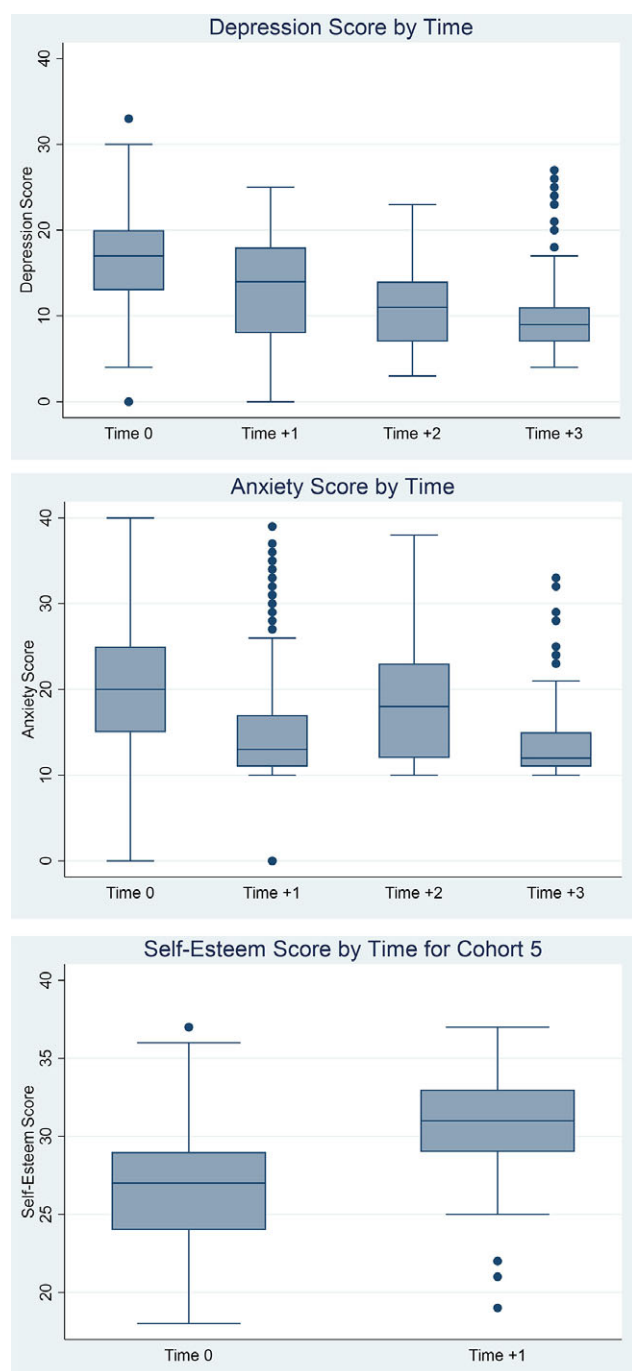


Figure 2. Boxplots of depression, anxiety and self-esteem average scores by time.

Cohort 5 missed five or more days in the last 4 weeks of school. This number decreased to six (3.4%) participants by posttest.

Multivariable regression analyses for mental health measures

Table 5 presents the multivariable regression results for anxiety and depression adjusting for cohort, district, grade level and SES. Anxiety and depression scores decreased significantly from pretest to posttreatment by an average of four to five points. The probability of screening positive for anxiety declined by about half post-participation in HiH compared to the pretest (RR = 0.46, 95%

Table 5. Regression models for anxiety and depression, all cohorts ($N = 438$; observations = 1,462)

	Score		Screened positive	
	Anxiety B	Depression B	Anxiety RR	Depression RR
Posttreatment	−4.20***	−5.61***	0.46***	0.27***
Cohort 1 (ref)				
Cohort 2	−0.69	0.35	1.15	2.02**
Cohort 3	−0.12	1.46***	1.00	2.27***
Cohort 4	1.23*	1.21**	1.32***	2.08***
Cohort 5	1.80**	−1.98***	1.20*	0.73
District 1 (ref)				
District 2	−1.51***	0.20	0.70***	1.06
Less grade 6 (ref)				
Grade 6	−0.11	0.03	0.93	1.01
Greater Grade 6	0.26	0.12	0.98	0.98
SES – low	0.72	0.54	1.10	1.44***
SES – medium	0.28	0.63	1.10	1.43**
SES – high (ref)				

*** $p < 0.001$, ** $p < 0.05$, * $p < 0.01$.

CI = 0.41, 0.53). The probability of screening positive for depression declined by about 75% (RR = 0.27, 95% CI = 0.22, 0.32).

Multivariable regression analyses for self-esteem and education measures among Cohort 5

Table 6 presents the multivariable regression results for self-esteem and school absenteeism among Cohort 5 program participants. Models were adjusted for district, grade level and SES. From the pretest to the posttest, program participants increased their self-esteem score by an average of about four points ($\beta = 3.93$, 95% CI = 3.22, 4.64). Program participants had an average absenteeism rate of 10% on the pretest, which significantly decreased to 5.4% on the posttest (RR = 0.54, 95% CI = 0.40, 0.73), representing a 46.6% reduction.

Discussion

We evaluated the impact of the HiH music therapy program (Cikuri et al., 2021) on adolescent mental health and school attendance within communities supported by World Vision development programming in Kasai-Central province, DRC. Before beginning the program, one-third of the adolescent girls who were participating screened positive for depression, while 60% screened positive for anxiety. Immediately following the HiH program, the probability of screening positive for depression declined to one-fifth and for anxiety to 40%. After completion of the HiH program, median scores for depression continued to decline, whereas anxiety fluctuated, increasing at the first follow-up and decreasing again at the second follow-up. Improvements in mental health occurred in the context of ongoing trauma and insecurity and were sustained for up to 17 months following the program. Self-esteem improved from pre- to post-participation in the HiH program, while frequent absenteeism declined.

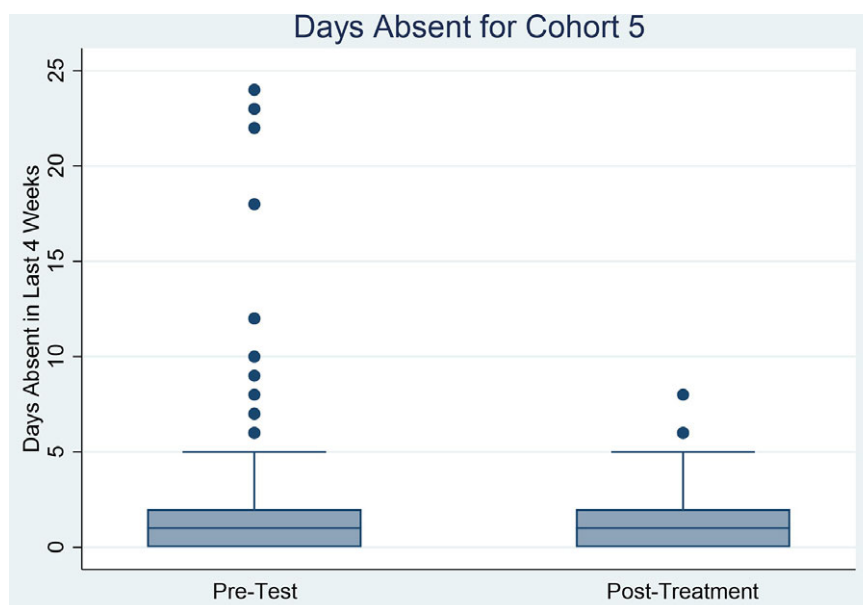


Figure 3. Boxplot of days absent over the last 4 weeks for Cohort 5 by pretest and posttest.

Table 6. Regression models for self-esteem and Poisson link model for school absenteeism, Cohort 5 only

	Cohort 5 only	
	Self-esteem B	Absenteeism rates % change
Posttreatment	3.93***	−46.6***
District 1 (ref)		
District 2	0.12	−6.1
Less grade 6 (ref)		
Grade 6	−0.05	−40.2
SES – low	0.66	98.0**
SES – medium	0.40	113.1**
SES – high (ref)		
Observations	356	351

*** $p < 0.001$, ** $p < 0.05$, * $p < 0.01$.

These findings are consistent with prior research documenting that psychotherapy reduces depression and anxiety when provided in the context of humanitarian crises (Bangpan et al., 2019; Purgato et al., 2018; Morina et al., 2017). Although the literature is limited, in a meta-analysis of 11 studies of mental health and psychosocial support (MHPSS) programs or interventions aimed at addressing common mental health disorders or challenges in humanitarian contexts among adults, the standardized mean differences (SMDs) in anxiety and depression were -0.69 and -0.71 , respectively (Bangpan et al., 2019), comparable to results of our study, which were -0.65 and -0.91 for anxiety and depression, respectively. Two meta-analyses of 13 studies and 43 randomized controlled studies examining psychological and psychosocial interventions for children and adolescents in LMICs also found that interventions involving cognitive behavioral therapy and group-based approaches were effective in reducing PTSD anxiety and depression (Uppendahl et al., 2020) (pooled SMD = -0.15 , 95% CI = -0.29 ,

-0.01) (Bangpan et al., 2024). Notably, we documented that the levels of depression continued to improve following completion of the program up through 17 months. However, $\sim 17\%$ of the children continued to screen positive for at least one of the two conditions 17 months after completing the program. Further research is needed to identify risk factors and appropriate interventions for chronic mental health problems in conflict settings.

The HiH program was implemented in a school-based program. Over 85% of the participants completed the program, providing additional evidence of schools' role in improving adolescents' access to mental health interventions (Grande et al., 2023; Partap et al., 2023). We found that frequent absenteeism declined among program participants, suggesting a potential added educational benefit of providing school-based mental health services.

Interpretation of results requires reflection on food insecurity during the data collection period. Leading into the period of Informed's data collection, villages in the area experienced significant inflation and a surge in market price from 0.5 to 2 USD per kilo for corn flour (maize meal), the main food staple between June and October 2022 (FEWS NET, 2022). Qualitative interviews carried out in December 2022 suggested higher prices, up to 10 USD per kilo, and participants identified food insecurity as impacting their mental conditions and increasing tension within and between families. This highlights the importance of food security for mental health and suggests the importance of integrating programs and coordinating across agencies and nongovernmental organizations to more effectively address mental health in the context of ongoing humanitarian crises.

We observed heterogeneity across cohorts in the timing of improvement in depression scores, with Cohorts 1–3 showing improvement only in the follow-up interviews, while Cohorts 4 and 5 showed improvement from the pretest to the posttest. This heterogeneity could be due to differences in the security contexts at the time of the intervention, differences in the time it took individuals to integrate the skills learned in the intervention or to increasing familiarity and skill of the program psychologists in delivering the intervention across time. It is also possible that the administration of the depression scale differed across the two data collection

teams. However, as discussed above, extensive efforts were made by the Informed team to ensure testing comparability.

This study had limitations. The program lacked clear inclusion criteria for program participation. This led to differences in age distribution by cohort, which cannot be fully accounted for by adjustment. The COVID-19 pandemic led to an alteration in programming for Cohort 1, which only received one HiH session per week, while Cohorts 2–5 had two sessions per week. This difference in dosage could not be fully accounted for in the analysis. Although the program design intended to include children not enrolled in school, the research team learned that partway through the program, implementation was narrowed to include only children enrolled in school. This limited the research's ability to examine the impact of MHPSS on school enrollment rates. The shift in the data collection team (from HiH program staff to Informed evaluators) may have led to inconsistent measurement; however, Informed made every effort to replicate training processes from the original team. As efforts to conduct follow-up interviews to evaluate the longer-term impacts of participation in HiH were only undertaken once Informed began data collection, time since completion of the program varied across cohorts. Thus, we cannot assess whether the shorter- and longer-term impacts differed across cohorts. The research study only included participants who completed the HiH program; therefore, selection bias is possible. Finally, we were not able to include a pretreatment comparison group to approximate a step-wedged design.

The study also has several strengths, including a large sample and multiple assessments per child. Information on mental health status was obtained before and up to 17 months after the program's completion, providing new information about the importance of longer-term follow-up in children to allow time for the integration of skills learned. Standardized instruments were used, and instruments were translated into Tshiluba. The study contributes to the scientific understanding of the value of psychosocial services in the context of ongoing insecurity.

In conclusion, this study found that the HiH music therapy program was associated with improvements in girl's depression and anxiety, with the most notable changes observed several months after program completion. In addition, we observed increases in participants' self-esteem and improved school attendance. These results align with previous research on the HiH, an integrated music and psychological care program, demonstrating its value in ongoing humanitarian crises. Further research should consider clinical comparative trials to evaluate the program's effectiveness. Additionally, exploring the societal impact of participants' songs and community engagement – such as potential reductions in stigma or increased social inclusion – would provide valuable insights (McFerran et al., 2020). These promising findings support scaling up the intervention, with the success of such expansion dependent on recruiting sufficient numbers of qualified psychologists to deliver the program.

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Data availability statement. The data supporting this study's findings are available from World Vision Canada. Restrictions apply to the availability of these data, which were used under license for this study. Data are available directly from World Vision Canada or the authors with permission from World Vision Canada.

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Author contribution. Lisa Zook and Sioban D. Harlow developed the study and carried out the study design. Ali Bitenga contributed to the study design, trained enumerators, oversaw data collection and contributed to data interpretation. Michelle M. Hood led the data analysis methodology while Lisa Zook carried out the data analysis. Sioban D. Harlow led the outline of the manuscript, while Lisa Zook led the manuscript writing. All authors discussed the results and contributed to the final manuscript, which included review, revision and edits.

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Competing interest. The authors declare no competing interests.

Ethical standard. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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