STRENGTHENING CHILD AND ADOLESCENT MENTAL HEALTH (CAMH) SERVICES AND SYSTEMS IN LOWER-AND-MIDDLE-INCOME COUNTRIES (LMICS)

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PUBLISHED IN: Frontiers in Psychiatry

frontiers Research Topics

ISSN 1664-8714
ISBN 978-2-88966-587-7
DOI 10.3389/978-2-88966-587-7

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STRENGTHENING CHILD AND ADOLESCENT MENTAL HEALTH (CAMH) SERVICES AND SYSTEMS IN LOWER-AND-MIDDLE-INCOME COUNTRIES (LMICS)

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Citation: Kumar, M., Bhat, A., Saxena, S., Unutzer, J., eds. (2021). Strengthening Child and Adolescent Mental Health (CAMH) Services and Systems in Lower-and-Middle-Income Countries (LMICs). Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88966-587-7

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frontiers in Psychiatry

EDITORIAL
published: 05 February 2021
doi: 10.3389/fpsyt.2021.645073

Editorial: Strengthening Child and Adolescent Mental Health (CAMH) Services and Systems in Lower-and-Middle-Income Countries (LMICs)

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Keywords: child and adolescent mental health, health systems strengthening, community based interventions, screening, school based intervention and prevention

The Editorial on the Research Topic

Strengthening Child and Adolescent Mental Health (CAMH) Services and Systems in Lower-and-Middle-Income Countries (LMICs)

Edited and reviewed by:
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Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Psychiatry

Received: *22 December 2020*
Accepted: *11 January 2021*
Published: *05 February 2021*

Citation:
Kumar M, Bhat A, Unützer J and Saxena S (2021) Editorial: Strengthening Child and Adolescent Mental Health (CAMH) Services and Systems in Lower-and-Middle-Income Countries (LMICs). Front. Psychiatry 12:645073. doi: 10.3389/fpsyt.2021.645073

RELEVANCE OF THIS SPECIAL TOPIC TODAY

More than half of all individuals living with mental illnesses present with their initial symptoms during childhood and adolescence (1). As more attention is paid to mental health in general, there is a growing realization that child and adolescent mental health in particular is inadequately understood and developed as a field. This is a global gap although the lack of support and service structures in low -and middle-income countries (LMICs) make it more challenging to assess the true burden. This lack of understanding of the true burden of child and adolescent mental health needs means it is more difficult to gather resources to develop systems and services to address this burden (2). This special edition aims to highlight the mental health needs of children and adolescents in LMICs by focusing on multilevel challenges, and on interventions and services, both novel and time-tested. A life course perspective in which assessment of child and adolescent development and psychosocial disturbances is integrated within existing systems can strengthen the entire health care system. This is pertinent for high income as well as low to middle income country settings. We decided to focus on LMICs as that is where most children and adolescents live and where there is the most need for CAMH professionals, services and system structures.

Since we published the final paper in this special topic, the SARS- COV-19 pandemic has taken the world by storm. Mental health services which were already stretched thin in most parts of the world have been critically impacted by the pandemic (3). Lockdowns and protracted closure of educational institutions, curfews preventing mobility of children and youth and high rates of financial instability due to job and business losses, illnesses and deaths due to COVID-19 infections, all led to increased rates of stress and poor mental health among children and adolescents (4). We hope these fifteen papers published between 2019 and 2020 will provide greater momentum to support CAMH, provide guidance on evidence based solutions to CAMH challenges, and help prioritize the well-being of children and youth during the pandemic and beyond.

OVERVIEW OF THE SPECIAL TOPIC

We accepted 15 articles from diverse country contexts including China, Ecuador, India, Kenya, Malawi, Nigeria, Pakistan, Sierra Leone, South Africa, and Uganda. We included two systematic reviews on CAMH interventions and policies and one scoping review on use of technology for CAMH. The papers covered a wide range of themes from child development in the context of maternal depression (De Oliveira et al. from Pakistan), child and adolescent mental health system and services at national and provincial levels (Mokatimi et al. from South Africa), emotional and behavioral problems in children living with HIV and the concordance of these with their caregivers (van dan Heuvel et al. from Uganda), maternal nutrition and offspring stress response (Krishnaveni and Srinivasan from India), youth mental health policy in Sub-Saharan Africa (Kutcher et al. covering Tanzania and Malawi), impact of poor socioeconomic status on development of psychopathology (Perez-Mafril from Equador), CAMH services in post-emergency context (from van dan Brink Sierra Leone), differences between adolescent and adult perinatal depression (Nigeria Oladije et al.), HIV disclosure and stigma related factors in adolescents living with HIV (Nabunya Nabunuya et al. from Uganda), and a task-shared trauma intervention targeting children (Dorsey et al. in Kenya).

We included two policy focused papers, including one using a sustainability science and action lens to look at adolescent mental health, and a contribution on development of a WHO led caregiver skills program targeting children with developmental disabilities, delays and disorders (Salomone et al.). Aside from these we published three scoping and systematic reviews: CAMH policy lessons and gaps across LMICs (Zhou et al.), the potential of digital mental health to bolster child well-being (Huang et al.) and psychotherapy in LMICs for depression, trauma and anxiety disorders in children and adolescents (Uppendahl et al.). A reflective policy-practice paper addressed urban sustainability and youth mental health (Murphy et al.).

Identification of Evidence-Based Interventions and Programs

These papers, and the exchanges we had with a number of pioneering researchers make it clear that there are many evidence-based approaches that can be integrated into heath care programming and service development in LMIC. Examples include using components of caregiver skills modules to support children with developmental disabilities (Salomone et al.) or trauma focused therapy delivered by lay community workers (Dorsey et al.), and the WHO led CST intervention which was designed to bridge a gap in addressing the needs of a highly vulnerable group of children with developmental disabilities and disorders.

Potential for Scaling Up

There is a critical need to scale up well-tested interventions and intervention strategies like task-sharing and task-shifting in LMICs. Lay and non-specialist health workers can be trained to provide screening and structured psychosocial interventions. Such activities can be carried out at community, school, college, and primary care levels in various LMIC contexts to capture diverse settings and resources that may be available (Oladije et al., De Oliviera et al.).

CHALLENGES FOR THE FIELD

Increase Investment in CAMH

We hope through this special topic to increase attention to the severe underinvestment in this field and how this is impacting the well-being of children, youth and families across the world. Investment is needed to improve financing, but also for comprehensive economic costing. We need to explore and embrace the financial and opportunity cost of intervening and setting up requisite, responsive systems and services for children, adolescents, and families in need.

Local Health, Community and Educational Capacity Building in Increasing Awareness and Toward Prevention and Promotion of Mental Health

The COVID-19 pandemic allows for opportunities to "build back better." Techniques to build resilience, parenting skills and problem solving, and strategies to reduce stigma should be developed in community, health as well as educational contexts so that children, adolescents and their caregivers receive necessary support to bolster mental and behavioral health. Involvement of sectors other than health is critical for development of robust mental health promotion and prevention programs and policies. Reflective pragmatic and well-structured research in CAMH has a critical role here in shaping and bolstering the evidence.

Several papers point to improved assessment and measurement tools for capturing child and adolescent psychopathology. Adaptations and modifications of measurement tools to offer more contextualized assessment of child and adolescent distress and psychopathology is critical. Developing policies and National level programs that support such measurement, early screening and intervention approaches continue to be important. Early interventions targeting pregnant women, interventions around maternal and parental mental health are key to making a timely impact.

Re-envisioning CAMH for LMICs During COVID-19

All countries of the world have been thrown into chaos with the rising numbers of infections, deaths and how families and communities are being impacted by the pandemic. Closures of learning institutions, care facilities for children and youth in need, and reduced possibilities of social networking, recreation and leisurely activities have impacted children and youth across the world. Children and adolescents in challenging situations such as children of migrants, internally displaced refugees, as well as families living in conflict, war or extreme poverty are particularly disenfranchised in this pandemic.

The motto of "building back better" in the context of mental health—has dual connotations—making missing CAMH structures in LMICs more robust, and bolstering services that are critically needed for recovery from the COVID-19 pandemic and beyond.

As can be seen from these papers risks such as poor nutrition, parental well-being, poverty and HIV remain critical issues for CAMH in LMICs. In such settings, the development of comprehensive and robust approaches that address social determinants through multimodal interventions and delivery platforms and a pragmatic and eclectic approach to intervention delivery may be particularly critical. Innovative strategies (Krishnaveni et al.) offered unique insight into maternal nutrition improvement to augment mental health and child well-being, Murphy et al. recommend the strategic framing and analysis of urban environment to address youth mental health, deep learning from colonial historical past to build back better mental health services in war and epidemic impacted regions—were recommendations from Mokatimi et al. and van dan Brink.

Approaches taken to strengthen policies and programs to improve child and adolescent mental health should be structured in developmentally appropriate ways, addressing barriers to mental health care and continually evaluating their effects on access to and outcomes of such services.

This vital scholarship has strengthened our conviction that service development, systems strengthening, and integration of effective mental health and substance use services in the broader context of health care need urgent prioritization in LMICs where the vast majority of children, adolescents, and families in need have little to no access to evidence-based care.

RESEARCH PRIORITIES GOING FORWARD

Developing analytic tools to assess the long term impacts of COVID-19 on CAMH populations is especially important. For example, Christakis et al. (5) found that the decision to close US public primary schools in the early months of 2020 may be associated with a decrease in life expectancy for US children and associate this to over 5.53 million years lost. This estimate is for one of the highest income countries of the world. We do need such appraisals for countries badly impacted by COVID- such as Brazil, China, India, Columbia and also for those countries undergoing humanitarian and economic crises such as Yemen, Syria, Iraq, Afghanistan, Bolivia, etc. A special focus on countries that have poor to on CAMH structures, services or policies will be important.

There is a need for low cost and robust implementation strategies to reduce treatment gap, especially in very low resource environments. We need a research tested and accredited set of implementation tools which would enable uptake of low intensity interventions and strategies that would improve mental health outcomes of children, youth and families. Most implementation research has emerged from high income countries and tends to be focused on simplistic frameworks that do not capture the complexity of the LMIC structures or of multilevel social determinants in tandem. These health services and implementation models need to be piloted and advanced in LMICs.

CAMH friendly approaches to mental health promotion and resilience building is another pathway toward building positive competencies and skills that would enhance well-being. WHO/UNICEF nurturing care (7) and Lancet commission on child and adolescent mental health (6) have emphasized well-being by focusing on the future of children—this would necessitate action in terms of investment in early childhood, targeting prevention of commercial exploitation of children and youth, addressing climate change, poverty-reduction, social justice, right to education and health and promoting gender, racial and equity in keeping with the Sustainable Development Goals. Resilience building measures, life skills coaching and a capabilities framework were some suggestions toward developing a wholesome appraisal of well-being.

AUTHOR CONTRIBUTIONS

MK and SS drafted the outline. JU and AB edited. All authors read, revised, and approved the paper.

ACKNOWLEDGMENTS

We would like to thank all our authors who participated in this special topic.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers
in Psychiatry

ORIGINAL RESEARCH
published: 11 July 2019
doi: 10.3389/fpsyt.2019.00460

Agreement and Discrepancy on Emotional and Behavioral Problems Between Caregivers and HIV-Infected Children and Adolescents From Uganda

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OPEN ACCESS

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Reviewed by:
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Specialty section:
This article was submitted to
Child and Adolescent Psychiatry,
a section of the journal
Frontiers in Psychiatry

Received: *20 December 2018*
Accepted: *11 June 2019*
Published: *11 July 2019*

Citation:
van den Heuvel LL, Levin J, Mpango RS, Gadow KD, Patel V, Nachega JB, Seedat S and Kinyanda E (2019) Agreement and Discrepancy on Emotional and Behavioral Problems Between Caregivers and HIV–Infected Children and Adolescents From Uganda. Front. Psychiatry 10:460. doi: 10.3389/fpsyt.2019.00460

Background: HIV-infected children and adolescents (CA-HIV) face significant mental health challenges related to a broad range of biological and psychosocial factors. Data are scarce on the agreement and discrepancy between caregivers and CA-HIV regarding emotional and behavioral problems (EBPs) in CA-HIV.

Objectives: We determined agreement between self- versus caregiver- reported EBPs and describe factors associated with informant discrepancy among caregiver–youth dyads who participated in the "Mental health among HIV-infected CHildren and Adolescents in KAmpala and Masaka, Uganda" (CHAKA) study.

Methods: In a cross-sectional sample, caregiver-reported EBPs were assessed with the Child and Adolescent Symptom Inventory-5 (CASI-5), and self-reported problems were evaluated with the Youth Inventory-4 (YI-4) in 469 adolescents aged 12–17 years and the Child Inventory-4 (CI-4) in 493 children aged 8–11 years. Adolescents were questioned about experiences of HIV stigma. Caregiver psychological distress was assessed with the Self-Reporting Questionnaire (SRQ-20). Linear regression models were applied to identify variables associated with discrepancy scores.

Results: Self-reported emotional problems (EPs) were present in 28.8% of adolescents and 36.9% of children, and 14.5% of adolescents self-reported behavioral problems (BPs). There was only a modest correlation ($r \leq 0.29$) between caregiver- and CA-HIV-reported EBPs, with caregivers reporting more EPs whereas adolescents reported more BPs. Informant discrepancy between adolescents and caregivers for BPs was associated with adolescent age and caregiver's employment and HIV status. Among adolescents, EP discrepancy scores were associated with adolescent's WHO HIV clinical stage, caregiver level of education, and caregivers caring for other children. Among children, EP discrepancy scores were associated with child and caregiver age, caregiver level of education, and caregiver self-rated health status. HIV stigma and caregiver psychological distress were also associated with discrepancy, such that adolescents who experienced HIV stigma rated their EPs as more severe than their caregivers did and caregivers with increased psychological distress rated EBPs as more severe than CA-HIV self-rated.

Conclusions: EBPs are frequently endorsed by CA-HIV, and agreement between informants is modest. Informant discrepancy is related to unique psychosocial and HIV-related factors. Multi-informant reports enhance the evaluation of CA-HIV and informant discrepancies can provide additional insights into the mental health of CA-HIV.

Keywords: children, adolescents, HIV, emotional problems, behavioral problems, caregiver report, self-report, discrepancy

INTRODUCTION

Of the 36.7 million people living with HIV in 2016, 52.9% (19.4 million) were residing in Eastern and Southern Africa (1). In Uganda in 2016, there were 1.4 million people living with HIV, of which 130,000 were under the age of 15 years (2). Despite the high health care burden of HIV in Sub-Saharan Africa, the majority of studies evaluating the mental health of HIV-infected children and adolescents (CA-HIV) have been conducted in developed regions (3). Generally, studies show that CA-HIV have high rates of medical and psychiatric morbidity (3–7). An earlier review of psychiatric disorders in CA-HIV based on the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*) nosology reported an average prevalence across studies of 28.6% for attention deficit hyperactivity disorder (ADHD), 24.3% for anxiety disorders, and 25.0% for depression (8). When rates of mental health problems are compared to other high-risk groups, such as HIV-exposed but uninfected youth or youth from HIV-affected households (e.g., AIDS orphans or HIV-infected caregivers), results tend to be more mixed (3, 6, 7, 9–12). Studies from African countries with a high prevalence of HIV have also found clinically significant rates of mental health problems. For example, in a Kenyan study, 48.8% of CA-HIV received a *DSM-IV*-based diagnosis (13), and an earlier cross-sectional Ugandan study in antiretroviral (ARV) naive adolescents found that over half (51.2%) self-reported significant psychological distress, and anxiety (45.6%) and depression (40.8%) were the most common International Classification of Diseases (ICD) psychiatric disorders (14).

CA-HIV from both high-income and resource-limited settings face increased mental health challenges that are related to a broad range of biopsychosocial factors (3, 15), such as overall health status, cognitive functioning, caregiver general health and mental health status, stressful life events, neighborhood stressors, and a lack of social support (3). HIV clinical disease factors, such as CD4 cell count and viral load, have not consistently been linked to poorer mental health outcomes; some studies have reported relations between indicators of HIV progression and mental health problems (16–19), whereas others have found no clear links (5, 10, 20, 21). Further, the presence of psychiatric disorders in CA-HIV has been associated with increased risk behaviors, including substance abuse, treatment non-adherence, and early-onset sexual intercourse (22–25). Stigma, related to being HIV positive, is another factor impacting the well-being of CA-HIV. Meta-analyses have demonstrated that HIV-related stigma is associated with various negative outcomes, including adverse mental health outcomes, such as increased depression, anxiety, and psychological distress (26). Similarly, studies in Africa have demonstrated an association between HIV stigma and increased mental health problems in both adult and adolescent samples (23, 27–29).

There is general consensus that a thorough assessment of child and adolescent mental health problems requires integrating information from various sources, including caregivers, educators, health care providers, and youth self-report (30, 31). Children and adolescents can provide information that may not be known to caregivers such as internal experiences (e.g., thought content, affect) or symptoms and behaviors that occur in contexts where caregivers are not present, such as school or peer interactions (32, 33). Certain problems may be underreported by caregivers, such as abuse and neglect by caregivers, and youth may keep some behaviors hidden from caregivers such as substance use or antisocial behaviors (33). Furthermore, youth self-report can assist in improving accuracy of certain diagnoses, in treatment planning, and in determining the reliability of caregiver information (33). Youth self-report can also provide unique insights into CA-HIV. For instance, in one study, CA-HIV reported elevated depression scores compared to HIV-negative youth, whereas there were no differences by youth HIV status for internalizing or externalizing problems according to caregiver reports (34). Furthermore, a multisite study in CA-HIV and HIV-affected youth found that having received prior mental health interventions was associated with caregiver-reported emotional and behavioral problems (EBPs), but not with youth self-reported EBPs, suggesting that youth self-report may be overlooked in routine practice (35).

Overall, agreement between caregiver-reported and youth self-reported problems is modest at best (32, 36, 37). Studies in CA-HIV have similarly reported low agreement between caregiver and youth self-report (5, 7). The agreement between reports from different informants, while providing information regarding different perspectives and contexts, does not reflect inter-rater reliability (30, 31, 36). For example, research has shown that the correlation between informants does not change much over time, whereas the correlation within informants does change substantially over time (36).

Research has consistently demonstrated discrepancies between different informants about child EBPs (38). As each informant provides a unique contribution to the assessment of EBPs, disagreements that may arise from informant reports can provide more information than when informants agree (36). Discrepancies between caregiver and youth report may provide additional information above each report alone, such as contextual variations in symptoms and treatment response, the individual characteristics of the informants, and features of the caregiver–child relationship (39). For instance, discrepancies in parent- and child self-reported social functioning among youth with autism spectrum disorder provided additional information about parental self-efficacy, youth psychopathology, and treatment response and predicted outcomes better than parent or youth self-report alone (39). Furthermore, another study demonstrated that teacher–adolescent pretreatment discrepancy about prosocial behaviors predicted post-treatment caregiver-rated improvements, whereas the actual ratings of the teachers and adolescents individually did not. Adolescents showed greater improvements according to caregiver report if teachers rated their prosocial behaviors as better than adolescents did themselves, again demonstrating the value of multi-informant report (40).

Discrepancies between caregiver and youth self-reports have been associated with the development of child psychopathology, caregiver stress, and problems in the caregiver–child relationship, although there is no clear patterning between informant characteristics and discrepancies (38). Caregiver psychopathology, and in particular depression, has been one of the most consistent factors associated with informant discrepancy of EBPs (38). Caregivers who are depressed or anxious rate their children's EBPs as more severe than other informants, such as teachers and youth themselves (38). Furthermore, a meta-analysis revealed that the association between maternal depression and child EBPs was significantly greater if maternal report was used as compared to child self-report, a combination of mother and child self-report, or reports from teachers or others (41). Inconsistencies in the association between caregiver psychological distress and informant discrepancy pertain mainly to specifics, such as whether anxiety or depression is the primary factor contributing to discrepancy or how the child's age and gender influence the outcomes (38).

EBPs are associated with adverse outcomes among CA-HIV, yet the source of information used to establish their presence is often not taken into consideration. Discrepancy between informants can provide more information than informant reports alone (36, 39). Moreover, informant discrepancies have also been associated with poorer treatment outcomes (42–44). Yet, informant discrepancy of EBPs have not been evaluated among CA-HIV, a group facing additional challenges, such as parental illness, orphanhood, HIV stigma, and HIV disease and treatment-related factors (3, 15, 26). Caregivers of HIV-infected children also face increased challenges, such as financial strain, food insecurity, parenting stress, anxiety, depression, and difficulties pertaining to accessing health care services and treatment adherence (45–49). Studies have also demonstrated discrepancies between caregiver and youth-reported barriers to ART adherence, thus further demonstrating the value of assessing informant discrepancy among CA-HIV (50). Evaluating informant discrepancy of EBPs in CA-HIV can provide further insights into the factors affecting mental health outcomes in CA-HIV and thus help inform treatment strategies.

The primary objective of this study was to better understand the clinical correlates of informant discrepancy between caregiver-reported and CA-HIV self-reported *DSM-5*-referenced EBPs. To the best of our knowledge, this is the first study to examine the clinical implications of informant discrepancy among CA-HIV. The study sample comprised youth who were participating in the *Mental health among HIV-infected CHildren and Adolescents in KAmpala and Masaka, Uganda* (CHAKA) study. Specifically, we describe relations between informant discrepancy and a range of sociodemographic and HIV-related factors for the symptoms of a number of common child and adolescent EBPs. Additionally, we investigate the association of HIV stigma and caregiver psychological distress with informant discrepancy. We also report on the prevalence of self-rated EBPs as compared to caregiver-rated EBPs and assessed the level of agreement. Based on existing research (36, 51), we hypothesized that CA-HIV would self-rate a greater number and severity of EBPs than caregivers.

MATERIALS AND METHODS

Study Design

The CHAKA study assessed the prevalence of, and factors associated with, psychiatric disorders among CA-HIV. Participants were recruited between January 2014 and June 2015. Published manuscripts addressing other research questions emanating from this study can be reviewed for further details (52–55). The study was conducted in accordance with the Declaration of Helsinki and ethical approval was obtained from the Uganda Virus Research Institute's Research and Ethics Committee, the Ethics Committee of the London School of Hygiene and Tropical Medicine, and the Uganda National Council of Science and Technology.

Setting

A sample of 1,339 child/adolescent–caregiver dyads was recruited from five HIV clinics in central and southwestern Uganda, three in the rural Masaka district (the AIDS Support Organisation clinic, Kitovu Mobile AIDS organisation, and the Uganda Cares clinic) and two in the urban Kampala City Council (Joint Clinical Research Centre and Nsambya Homecare Department). Eligible participants were recruited from each study site consecutively until the required sample size was attained. An equal number of 268 dyads was planned for recruitment at each site. Interviews were conducted in partitioned tents that were erected at each of the study sites to ensure privacy and limit distraction.

Participants

CA-HIV between 5 and 17 years of age with caregivers older than 17 years of age were included. Additionally, participants were included if both caregivers and CA-HIV could speak English or Luganda (the local language spoken in the study areas), and they remained in the study's geographical area for the subsequent 12 months. Participants were excluded if they were concurrently enrolled in another study, if they were unwell and in need of immediate medical attention, and if they did not understand the study instruments for any reason. Furthermore, to be able to address the objectives of this study, we only included CA-HIV who had completed the self-report measures for EBPs. Eligible study participants provided written informed consent (caregiver) and assent (CA-HIV) after explanation of the study objectives and procedures. No CA-HIV were enrolled without their assent, and all participants were informed that they could withdraw without prejudice at any time. In the majority of cases, the parents provided informed consent for participation of the CA-HIV, but in cases where the primary caregivers were not parents, the guardians of the CA-HIV provided the informed consent. Approximately 2% of participants assessed for eligibility were not included due to factors such as caregiver refusal, CA-HIV refusal, inability to contact the caregiver to obtain consent, and ongoing participation in another study.

Procedure

The assessment battery comprised structured, standardized, and locally translated instruments. Measures not previously used in Uganda were forward and back translated and locally adapted and piloted before use (52, 55). Assessments were administered by trained psychiatric nurses and psychiatric clinical officers and supervised by a psychiatrist and a clinical psychologist. All measures used were read to participants to accommodate for variation in reading level. Participants diagnosed with putative psychiatric disorders were provided with psychoeducation and referred to local mental health care services. A demographic questionnaire was designed to obtain sociodemographic information of caregivers and CA-HIV [e.g., age, gender, employment status, highest level of education (HLOE), caregiver relationship to child] and a medical questionnaire to obtain data regarding caregiver and child health status (e.g., nadir CD4, current CD4, ART status, caregiver HIV status).

Measures

Emotional and Behavioral Problems

Caregivers completed the parent version of the *Child & Adolescent Symptom Inventory-5* (*CASI-5*) (56), which includes the symptoms of *DSM-5* psychiatric disorders among youth aged between 5 and 18 years old. Symptoms are rated on a four-point Likert scale (0—*never*, 1—*sometimes*, 2—*often*, 3—*very often*) with an impairment rating (rated on the same Likert scale as symptoms) for each disorder. The CASI-5 can be utilized to obtain a *symptom cutoff score* (number of symptoms required for a *DSM-5* diagnosis rated "2" or higher), an *impairment cutoff score* (impairment rated "2" or higher, regardless of number of symptoms), a *clinical cutoff score* (has to fulfill both symptoms cutoff and impairment cutoff scores), and a *symptom severity score* (dimensional model). The symptom severity scores are calculated by adding the individual ratings of each of the symptoms for each disorder. We evaluated for the presence of EBPs utilizing the symptom cutoff score (see **Table 1**) and used

TABLE 1 | Emotional and behavioral problems as assessed with rating scales.

Problems assessed	CASI-5[a]	YI-4[b]	CI-4[c]
Behavioral problems			
Attention deficit hyperactivity disorder (ADHD)	AS	AS	–
Oppositional defiant disorder (ODD)	AS	AS	–
Conduct disorder (CD)	AS	AS	–
Substance use disorder (SUD)	SQ(s)	SQ(s)	–
Emotional problems			
Anxiety disorders			
Generalized anxiety disorder (GAD)	AS	AS	AS
Specific phobia	SQ(s)	SQ(s)	SQ(s)
Panic disorder	SQ(s)	SQ(s)	–
Social anxiety disorder (SAD; social phobia)	AS	SQ(s)	SQ(s)
Separation anxiety disorder	AS	SQ(s)	AS
Mood disorders			
Major depressive episode (MDE)	AS	AS	AS
Persistent depressive disorder (dysthymia)	AS	AS	AS
Related disorders			
Posttraumatic stress disorder (PTSD)	SQ(s)	SQ(s)	SQ(s)
Somatic symptom disorder	SQ(s)	SQ(s)	SQ(s)

[a] *Administered to caregivers.*
[b] *Administered to adolescents (ages 12–17 years).*
[c] *Administered to children (ages 8–11 years).*
AS; all symptoms; CASI-5, Child & Adolescent Symptom Inventory-5; CI-4, Child Inventory-4; SQs, screening question(s); YI-4, Youth's Inventory-4.

the severity scores to calculate discrepancy on EBPs. The CASI has been used in hundreds of studies (57), including in HIV-positive youth (7), and has demonstrated satisfactory psychometric properties, including internal consistency (Cronbach's α between 0.45 and 0.92), test–retest reliability ($r > 0.65$), and convergent, divergent, and discriminant validity in various settings (58–61). The CASI-5 was adapted for use in the local Ugandan setting (52) and internal consistency was satisfactory (Cronbach's α between 0.70 and 0.85) (55).

Adolescents between 12 and 18 years old completed the *Youth's Inventory-4* (*YI-4*) (62), which is a self-report measure of *DSM*-referenced symptoms. The YI-4 comprises 120 items that correspond to items in the CASI-5 and is rated and scored in a similar way to the CASI-5. The YI-4 has demonstrated satisfactory internal consistency (Cronbach's α between 0.66 and 0.87) and test–retest reliability (r between 0.54 and 0.92) and aligns well with other self-report measures and clinical diagnoses (33). Internal consistency in this study was also fair (Cronbach's α between 0.49 and 0.88) (55).

The Child Self-Report Inventory-4 (*CI-4*) (63) is a parallel self-report measure for use with children aged between 8 and 11 years and includes 34 items that are phrased and rated similarly to the YI-4 and CASI-5, but does not include an impairment rating. The CI-4 rates only for EPs (**Table 1**), and thus, for the child sample, results are limited to EPs. Formal validation studies have not yet been published regarding the CI-4, although it has been used in other studies of HIV-positive children (61, 64). In this sample, the internal consistency of disorders assessed (Cronbach's α between 0.62 and 0.79) as well as the full scale (Cronbach's α = 0.89) was satisfactory.

Caregiver Psychological Distress

The Self-Reporting Questionnaire (*SRQ-20*) (65) is a brief measure developed by the WHO to screen for common mental problems, such as depression and anxiety, in developing countries. Respondents indicate the presence or absence of 20 symptoms in the prior month by answering yes (scored 1) or no (scored 0) to each item. Items are summed to provide a total score (range 0–20), with higher scores indicating greater symptomatology. The SRQ-20 has been translated and validated for use in Uganda and demonstrated good internal consistency (Cronbach's α = 0.84) and moderate test–retest reliability (κ = 0.48), and a cutoff score of ≥6 identified current depression with a sensitivity of 84% and specificity of 93% (66). The SRQ-20 was administered to caregivers to assess psychological distress and demonstrated good internal consistency (Cronbach's α = 0.83).

HIV Stigma

To assess for HIV-related stigma, adolescents were asked five questions (yes/no) pertaining to stigma experienced in the prior year. The questions asked about i) being teased at home because of HIV status, ii) being teased at school/work because of HIV status, iii) being discriminated at home because of HIV status, iv) being discriminated at school/work because of HIV status, and v) having lost friends because of HIV status. Adolescents responding "yes" to any of the questions were regarded as having experienced HIV stigma in the prior year (yes/no).

Clinical Correlates

Child/adolescent characteristics: Gender (male/female), age (continuous in years), and whether the child missed any days of school in the last term (yes/no).

Household characteristics: Study site (rural/urban), who the child lives with (two parents, single parent, grandparents, other), food security (based on whether the household had enough food to eat in the prior month, yes/no), and socioeconomic index based on common household items (0–2, 3–4, 5–6, 7–9 items) constructed for use in Uganda (67) (including the following items: electricity, a car, a motorcycle, a bicycle, a radio, a telephone, a refrigerator, a cupboard, and a flask).

HIV characteristics: Whether the child was born with HIV (yes/no), nadir CD4 cell count (<200, 200–349, 350–499, 500+ cells/mm^3), current CD4 cell count (< 200, 200–349, 350–499, 500+ cells/mm^3), reported WHO HIV clinical stage (stage 1, stage 2, stage 3, stage 4), currently on antiretroviral treatment (ART, yes/no), possible virological treatment failure (current viral load > 1,000 copies/ml, yes/no), whether the adolescent missed any ARV doses in the past 3 days (yes/no), and whether HIV status has been disclosed to the child (yes/no).

Caregiver characteristics: Gender (male/female), age (continuous in years), caregiver status (mother, father, grandparent, other), employment (yes/no), HLOE (no formal education, primary education, secondary education, tertiary education), marital status (cohabiting, widowed, separated, single), caregiver also caring for other children (yes/no), caregiver HIV positive (yes/no), and caregiver health status (poor or average, good or very good).

EBPs: Rates of individual EBPs (as listed in **Table 1**) based on symptom cutoff scores on diagnostic measures are reported. Emotional problems (EPs) were considered present if the child or adolescent fulfilled symptom criteria for at least one EP. Behavioral problems (BPs) were considered present if the adolescent fulfilled symptom criteria for at least one BP. Similar to other studies that have used diagnostic tools (68, 69), we calculated total severity scores for EPs and BPs by adding the severity scores for the individual disorders (as presented in **Table 1**). With this approach, each symptom assessed would contribute equally to overall severity; however, total severity scores could be more heavily influenced by disorders with a greater number of symptoms. We, therefore, also calculated averaged total severity scores by dividing the severity score for each disorder by the number of symptoms assessed, which we used to conduct sensitivity analysis. By using averaged severity scores, each disorder would contribute equally to overall severity; however, disorders that were assessed with limited screening questions would be weighted equivalently to disorders that had been assessed in full.

Statistical Analysis

The sample size of 1339 was based on an estimated prevalence of at least one psychiatric disorder of 25% with a precision of around 2.5%. Analyses were conducted separately for the child and adolescent samples as they completed different self-report questionnaires; "adolescents" aged 12–17 years completed the YI-4 and "children" aged 8–11 years completed the CI-4. Descriptive data include rates (%) of self-rated and caregiver-rated EBPs and sociodemographic and clinical variables (as specified above). We compared the rates reported by the caregivers and CA-HIV by conducting chi-square or Fisher's exact tests as indicated.

Agreement between caregiver- and youth self-rated disorders was evaluated with the kappa statistic based on symptom cutoff scores (i.e., categorical) and Pearson correlation coefficients for severity scores (i.e., dimensional). To measure the discrepancy between caregivers and CA-HIV, we used a recommended approach by calculating standardized difference scores (69). We transformed each informant's total EP and total BP severity scores into z scores. We subtracted the z score obtained for the CA-HIV from the z score obtained for the caregivers to obtain the standardized difference (discrepancy) score for EPs and BPs. Positive scores indicate caregivers rating problems as more severe and negative scores indicate CA-HIV rating problems as more severe. We repeated the same process using averaged severity scores to compute the discrepancy scores, which were used in sensitivity analyses.

To identify clinical and sociodemographic factors that were associated with discrepancy between caregivers and CA-HIV on EPs or BPs, t tests and analyses of variance (ANOVAs) were conducted for categorical variables and Pearson correlation coefficients for continuous variables. Variables with a p value of less than 0.1 were entered into multiple linear regression models to assess factors that each best predicted the discrepancy between caregivers and CA-HIV of EPs and BPs. CA-HIV age and gender were included in each of the models, even if their p values were not significant on univariate analyses. To assess for the effects of HIV stigma and caregiver psychological distress on discrepancy scores, we added the variables "experienced HIV stigma" and "SRQ-20 total score" as an additional step to the final model. We conducted sensitivity analyses by repeating the regression models, but with discrepancy scores based on averaged severity scores as the dependent variables. We did not correct for multiple comparisons due to the exploratory nature of the analyses. Analyses were conducted using SPSS version 25 software package (SPSS Inc., Chicago, IL), and all tests were two-tailed with the alpha (α) set at 0.05.

RESULTS

Participants and Descriptive Data

The overall sample of 1,339 included 351 children under the age of 8 years who did not qualify for inclusion in this study, as they were too young to complete the CI-4. We excluded one adolescent aged 18 years and three CA-HIV for whom age data were missing. We excluded a further 18 children who had not completed the CI-4 and four adolescents who had not completed the YI-4. Our final sample included 493 children who had completed the CI-4 and 469 adolescents who had completed the YI-4. CASI-5 data were missing for 28 (5.9%) adolescents, and five (1.0%) children were excluded from the analysis as the caregivers who completed the CASI-5 were not above the age of 17 years. Factors associated with adolescents who were excluded (n = 33, 7.0%) were older age [$t(472) = 3.1$, $p = 0.002$], urban study site [$\chi^2(1) = 25.9$, $p < 0.001$], a higher socioeconomic index [$\chi^2(3) = 8.0$, $p = 0.047$], caregivers interviewed not the parents or grandparents [$\chi^2(3) = 24.7$, $p < 0.001$], and caregivers being employed [$\chi^2(1) = 5.3$, $p = 0.021$]. Factors associated with children who were excluded (n = 23, 4.5%) were urban study site [$\chi^2(1) = 10.7$, $p = 0.001$], WHO clinical stage 1 or 2 [$\chi^2(3) = 8.0$, $p = 0.046$], caregiver younger [$t(472) = -2.5$, $p = 0.012$], and caregiver not HIV positive [$\chi^2(1) = 4.1$, $p = 0.042$].

The mean age of CA-HIV was 11.9 (SD = 2.6) years, and 52.9% of CA-HIV were female. The majority of CA-HIV (94.2%) were perinatally infected and were receiving ART (95.4%). Eighty-seven (19.7%) of the adolescents reported experiencing HIV-related stigma in the prior year, with 31 (7.0%) answering "yes" to two or more questions. Of the caregivers assessed, 177 (19.1%) scored ≥6 on the SRQ-20 (the threshold indicating possible depression in the Ugandan validation study), and the median score on the SRQ-20 was 4.0 (IQR 0.0; 4.0). For detailed descriptive data, see **Tables 3** and **4**.

Rates of EBPs (Table 2)

Rates of Behavioral Problems

Adolescents

Based on symptom count cutoff scores, caregiver- and self- reported BPs were present among 9.2% and 14.5% of adolescents, respectively. Adolescents self-reported a mean number of 0.21 (SD = 0.58) BPs, and of those reporting BPs, 30.9% reported having at least two BPs. Adolescents self-reported more BPs than their caregivers [$\chi^2(1) = 4.8$, $p = 0.029$], particularly conduct disorder [$\chi^2(1) = 4.5$, $p = 0.034$] and substance use problems [$\chi^2(1) = 12.1$, $p < 0.001$].

Rates of Emotional Problems

Adolescents

Caregivers reported that 55.7% of adolescents met symptom count criteria for an EP compared with 28.8% according to adolescent self-report. The mean number of self-reported EPs was 0.54 (SD = 1.12), and of those adolescents reporting EPs, 43.7% met criteria for at least two, and 21.5% met criteria for at least three EPs. Caregivers reported more EPs than adolescents [$\chi^2(1) = 85.5$, $p < 0.001$], specifically higher rates of specific phobia [$\chi^2(1) = 76.8$, $p < 0.001$], panic attacks [$\chi^2(1) = 30.2$, $p < 0.001$], posttraumatic stress disorder (PTSD) [$\chi^2(1) = 58.0$, $p < 0.001$], somatic symptoms [$\chi^2(1) = 27.1$, $p < 0.001$], and separation anxiety disorder [$\chi^2(1) = 7.7$, $p = 0.006$]. Adolescents self-reported higher rates of social anxiety disorder [SAD, $\chi^2(1) = 28.9$, $p < 0.001$].

Children

Caregivers indicated that 54.8% of the children met criteria for an EP whereas 36.9% of the children self-reported EPs. The mean number of self-reported EPs was 0.64 (1.07), and of the children self-reporting EPs, 42.9% reported at least two EPs and 18.1% reported three or more. Caregivers reported more EPs than children [$\chi^2(1) = 33.5$, $p < 0.001$], specifically specific phobia [$\chi^2(1) = 45.3$, $p < 0.001$], PTSD [$\chi^2(1) = 42.3$, $p < 0.001$], and somatic symptoms [$\chi^2(1) = 19.3$, $p < 0.001$]. Children self-reported higher rates of SAD [$\chi^2(1) = 47.4$, $p < 0.001$].

TABLE 2 | Rates of caregiver and self-rated emotional and behavioral problems.

Problems assessed	Caregiver	Adolescent	χ^2	*p* value	Caregiver	Child	χ^2	*p* value
	n (%)	*n* (%)			*n* (%)	*n* (%)		
Total sample	441 (94.0)	469 (100)			488 (99.0)	493 (100)		
Total problems	273 (58.2)	166 (35.4)	63.97	<0.001*				
Total behavioral problems	43 (9.2)	68 (14.5)	4.79	0.029*				
ADHD	19 (4.3)	17 (3.6)	0.28	0.597				
ODD	15 (3.4)	18 (3.8)	0.12	0.725				
CD	25 (5.7)	44 (9.4)	4.47	0.034*				
SUD	2 (0.5)	18 (3.8)	12.11	<0.001*				
Total emotional problems	261 (55.7)	135 (28.8)	85.45	<0.001*	270 (54.8)	182 (36.9)	33.46	<0.001*
GAD	7 (1.6)	14 (3.0)	1.97	0.160	17 (3.4)	29 (5.9)	3.16	0.076
Specific phobia	189 (42.9)	77 (16.4)	76.80	<0.001*	223 (45.2)	124 (25.2)	45.28	<0.001*
Panic disorder	92 (20.9)	38 (8.1)	30.22	<0.001*				
SAD	8 (1.8)	49 (10.4)	28.86	<0.001*	14 (2.8)	77 (15.6)	47.37	<0.001
Separation AD	25 (5.7)	10 (2.1)	7.69	0.006*	27 (54.8)	41 (8.3)	2.95	0.086
MDE	11 (2.5)	4 (0.9)	3.78	0.068	5 (1.0)	2 (0.4)	1.33	0.285
PDD	19 (4.3)	24 (5.1)	0.33	0.565	9 (1.8)	14 (2.8)	1.06	0.303
PTSD	85 (19.1)	16 (3.4)	57.96	<0.001*	57 (11.6)	7 (1.4)	42.34	<0.001*
SSD	61 (13.8)	19 (4.1)	27.12	<0.001*	58 (11.8)	21 (4.3)	19.26	<0.001*

**Significance set at p < 0.05.*

AD, anxiety disorder; ADHD, attention deficit hyperactivity disorder; CD, conduct disorder; GAD, generalized anxiety disorder; MDE, major depressive episode; ODD, oppositional defiant disorder; PDD, persistent depressive disorder; PTSD, posttraumatic stress disorder; SAD, social anxiety disorder; SSD, somatic symptom disorder; SUD, substance use disorder.

Co-Occurrence

Comorbidity of EPs and BPs was also noted, with 41 (8.7%) adolescents and 31 (7.0%) caregivers reporting both EPs and BPs. The number of EPs reported was significantly correlated with the number of BPs reported by both caregivers ($r_s = 0.14$, $p = 0.004$) and adolescents ($r_s = 0.29$, $p < 0.001$).

Caregiver and Self-Report Agreement (Table 3)

Informant agreement was poor (κ between −0.023 and 0.122), with a maximum kappa of 0.122 ($p = 0.002$) for somatic symptom presence. There was also only modest agreement based on severity scores (*r* between −0.012 and 0.286).

TABLE 3 | Agreement between caregiver-rated and CA-HIV self-rated emotional and behavioral problems.

	Caregiver–adolescent agreement				Caregiver–child agreement			
	Kappa	*p* value	Correlation	*p* value	Kappa	*p* value	Correlation	*p* value
Behavioral problems	0.122	0.009*	0.252	<0.001*				
ADHD	0.073	0.123	0.286	<0.001*				
ODD	0.092	0.052	0.210	<0.001*				
CD	0.090	0.050	0.160	0.001*				
SUD	−0.008	0.770	−0.012	0.802				
Emotional problems	0.062	0.109	0.197	<0.001*	0.151	<0.001*	0.190	<0.001*
GAD	0.087	0.058	0.250	<0.001*	0.001	0.979	0.129	0.004*
Specific phobia	0.006	0.876	0.162	0.001*	0.067	0.103	0.178	<0.001*
Panic disorder	−0.009	0.827	0.067	0.162				
SAD	0.085	0.010*	0.152	0.001*	0.042	0.174	0.081	0.075
Separation AD	0.026	0.549	0.138	0.004*	0.055	0.216	0.108	0.017*
MDE	−0.013	0.748	0.209	<0.001*	−0.006	0.885	0.182	<0.001*
PDD	0.047	0.318	0.165	<0.001*	−0.023	0.603	0.175	<0.001*
PTSD	0.037	0.211	0.080	0.092	0.038	0.161	0.090	0.047*
SSD	0.037	0.351	0.169	<0.001*	0.122	0.002*	0.203	<0.001*

**Significance set at p < 0.05.*

AD, anxiety disorder; ADHD, attention deficit hyperactivity disorder; CD, conduct disorder; GAD, generalized anxiety disorder; MDE, major depressive episode; ODD, oppositional defiant disorder; PDD, persistent depressive disorder; PTSD, posttraumatic stress disorder; SAD, social anxiety disorder; SSD, somatic symptom disorder; SUD, substance use disorder.

Factors Associated With Caregiver and CA-HIV Discrepancy

Discrepancy scores were all positive, indicating that overall caregivers rated increased severity of EBPs than CA-HIV. The discrepancy scores between EPs and BPs in adolescents were also significantly correlated ($r = 0.66$, $p < 0.001$). The association between caregiver and CA-HIV discrepancy and sociodemographic and clinical factors based on univariate analyses are reported in **Tables 4** and **5** for adolescents and children, respectively.

Adolescent Behavior Problems

Discrepancy scores for BPs were significantly different by caregiver employment status [$t(439) = -2.10$, $p = 0.036$] and caregiver HIV status [$t(435) = 1.97$, $p = 0.049$]. These variables were added to the linear regression model along with caregiver caring for other children [$t(439) = -1.75$, $p = 0.080$], caregiver gender [$t(439) = -1.67$, $p = 0.097$], adolescent gender [$t(439) = -1.35$, $p = 0.179$], and adolescent age ($r = -0.09$, $p = 0.072$) (**Table 6**). Discrepancy on BP scores were associated with adolescent age ($B = -0.09$, 95% CI −0.17; −0.01, $p = 0.037$), caregiver employment status ($B = 0.33$, 95% CI 0.00; 0.67, $p = 0.049$), and caregiver HIV status ($B = -0.26$, 95% CI −0.50; −0.02, $p = 0.037$). Discrepancy scores decreased with advancing adolescent age and caregivers rated BPs as less severe than adolescents if caregivers were HIV positive and unemployed.

Discrepancy scores were significantly associated with caregiver SRQ-20 scores ($r = 0.10$, $p = 0.045$), but not with HIV stigma experienced by adolescents [$t(439) = -0.86$, $p = 0.391$]. When these variables were added to the model, the model was significantly improved (R^2 change = 0.015, $p = 0.031$) and discrepancy scores were significantly associated with caregiver SRQ-20 scores ($B = 0.04$, 95% CI 0.01; 0.08, $p = 0.011$), such that caregivers with higher levels of psychological distress rated BPs as being more severe than adolescents self-rated.

Adolescent Emotional Problems

Discrepancy scores for EPs were significantly associated with adolescent age ($r = -0.13$, $p = 0.009$), CA-HIV WHO HIV clinical stage [$F(3, 437) = 3.83$, $p = 0.010$], caregiver age ($r = -0.10$, $p = 0.036$), caregiver HLOE [$F(3, 435) = 5.14$, $p = 0.002$], and caregiver caring for other children [$t(439) = -1.99$, $p = 0.047$]. These variables were added to the linear regression model along with adolescent gender [$t(439) = -1.38$, $p = 0.169$] and study site [$t(439) = -1.76$, $p = 0.079$] (**Table 7**). Discrepancy in EPs was significantly associated with WHO HIV stage 4 ($B = 1.47$, 95% CI 0.59; 2.34, $p = 0.001$), caregivers caring for other children ($B = 0.32$, 95% CI 0.02; 0.62, $p = 0.038$), and a tertiary HLOE in caregivers ($B = 0.77$, 95% CI 0.26; 1.27, $p = 0.003$). Caregivers rated EPs as being more severe than adolescents if the adolescents had WHO HIV stage 4 compared to stage 1, if the caregiver had a tertiary HLOE as compared to no formal education, and if the caregiver was also caring for other children.

Discrepancy scores were significantly associated with caregiver SRQ-20 scores ($r = 0.17$, $p < 0.001$) and with HIV stigma experienced by adolescent [$t(439) = -2.19$, $p = 0.029$]. The model was significantly improved (R^2 change = 0.041, $p < 0.001$) when these variables were added and discrepancy scores were significantly associated with HIV stigma experienced by adolescents ($B = -0.37$, 95% CI −0.67; −0.08, $p = 0.012$) and with caregiver SRQ-20 scores ($B = 0.07$, 95% CI 0.03; 0.10, $p = 0.011$). Caring for other children was no longer significantly associated with discrepancy scores ($B = 0.30$, 95% CI −0.03; 0.73, $p = 0.057$). Adolescents who had experienced stigma in the prior year rated EPs as more severe than caregivers and caregivers with increased psychological distress rated EPs more severe than adolescents self-rated.

To assess for possible effects related to the context in which adolescents had experienced HIV-related stigma, we performed *post hoc* testing by repeating the final model, but dividing HIV stigma according to those who endorsed stigma at home only, outside the home only, or in both settings. Adolescents who experienced stigma at home only ($B = -0.70$, 95% CI −1.20; −0.20, $p = 0.007$), but not outside the home only ($B = -0.31$, 95% CI −0.68; 0.06, $p = 0.097$) or in both settings ($B = 0.03$, 95% CI −0.67; 0.74, p = 0.926), self-rated their EPs as significantly more severe than their caregivers rated, compared with adolescents who did not endorse experiencing HIV-related stigma.

Child Emotional Problems

Discrepancy scores for EPs were associated with child age ($r = 0.10$, $p = 0.011$), CA-HIV WHO HIV clinical stage [$F(3, 484) = 2.84$, $p = 0.037$], caregiver age ($r = -0.12$, $p = 0.011$), caregiver HLOE [$F(3, 484) = 4.37$, $p = 0.005$], and caregiver health status [$t(485) = 2.01$, $p = 0.045$]. These factors were added to the linear regression model along with study site [$t(486) = -1.92$, $p = 0.056$] and child gender [$t(486) = 0.11$, $p = 0.913$] (**Table 8**). Discrepancy in reporting EPs was significantly associated with child age ($B = -0.16$, 95% CI −0.26; −0.06, $p = 0.003$), caregiver age ($B = -0.01$, 95% CI −0.02; −0.00, $p = 0.030$), caregiver health status ($B = -0.31$, 95% CI −0.54; −0.08, $p = 0.007$), and caregivers having a primary ($B = 0.43$, 95% CI 0.04; 0.82, $p = 0.031$), secondary ($B = 0.62$, 95% CI 0.21; 1.04, $p = 0.004$), and tertiary HLOE ($B = 0.80$, 95% CI 0.25; 1.34, $p = 0.004$). Discrepancy scores decreased with advancing child and caregiver age. Caregivers rated EPs as more severe than children rated EPs if caregivers rated their own health status as “average” or “poor” as compared to “good” or “very good” or if caregivers had any level of education as compared to no formal education.

Discrepancy scores were significantly associated with caregiver SRQ-20 scores ($r = 0.22$, $p < 0.001$), and the model was significantly improved when SRQ-20 scores were added to the model (R^2 change = 0.029, $p < 0.001$). Discrepancy scores were significantly associated with caregiver SRQ-20 scores ($B = 0.07$, 95% CI 0.04; 0.10, $p = 0.011$). Caregiver age ($B = -0.01$, 95% CI −0.02; 0.00, $p = 0.079$) and caregiver health status ($B = -0.13$, 95% CI −0.37; 0.11, $p = 0.273$) were no longer significantly associated with discrepancy scores, with a pronounced change for caregiver health status. Similar to adolescents, caregivers with increased psychological distress rated EPs as more severe than children self-rated.

TABLE 4 | Association of demographic and clinical variables to the standardized difference score for emotional and behavioral problems between caregivers and adolescents.

		Emotional problems			Behavioral problems		
Variable	**Total sample**	**Std difference score**	**Test statistic**	***p* value**	**Std difference score**	**Test statistic**	***p* value**
		M (SD)			**M (SD)**		
Total sample *n* (%)	441 (100)	0.00 (1.27)			0.00 (1.22)		
Child/adolescent characteristics							
Gender *n* (%)			*t* (439) = −1.38	0.169		*t* (439) = −1.35	0.179
Female	230 (52.2)	−0.08 (1.21)			−0.08 (1.15)		
Male	211 (47.8)	0.09 (1.32)			0.08 (1.30)		
Age M (SD)	13.88 (1.44)		*r* = −0.13	0.009*		*r* = −0.09	0.072
Missed any school *n* (%)			*t* (401) = −0.64	0.521		*t* (401) = 0.12	0.906
No	170 (38.5)	−0.05 (1.25)			0.02 (1.20)		
Yes	233 (57.8)	0.03 (1.29)			0.00 (1.21)		
Experienced HIV stigma *n* (%)			*t* (439) = −2.19	0.029*		*t* (439) = −0.86	0.391
No	354 (80.3)	0.06 (1.3)			0.03 (1.2)		
Yes	87 (19.7)	−0.27 (1.3)			−0.10 (1.3)		
Household characteristics							
Study site *n* (%)			*t* (439) = −1.76	0.079		*t* (439) = 0.41	0.679
Rural	215 (48.8)	−0.11 (1.16)			0.03 (1.21)		
Urban	226 (51.2)	0.10 (1.35)			−0.02 (1.23)		
Lives with *n* (%)			*F* (3, 437) = 0.21	0.889		*F* (3, 437) = 1.86	0.136
Two parents	106 (24.0)	0.04 (1.26)			−0.03 (1.04)		
Single parent	143 (32.4)	−0.07 (1.29)			−0.15 (1.20)		
Grandparents	87 (19.7)	0.05 (1.08)			0.23 (1.19)		
Other	105 (23.8)	0.02 (1.40)			0.04 (1.42)		
Food security *n* (%)			*t* (436) = 0.34	0.731		*t* (436) = −1.58	0.116
No	94 (21.3)	0.04 (1.37)			−1.76 (1.38)		
Yes	344 (78.5)	−0.01 (1.24)			0.05 (1.18)		
Socioeconomic index *n* (%)			*F* (3, 430) = 0.85	0.470		*F* (3, 430) = 0.33	0.804
0–2	37 (8.5)	0.15 (1.02)			0.11 (1.13)		
3–4	144 (33.2)	0.00 (1.23)			0.03 (1.22)		
5–6	178 (41.0)	−0.10 (1.40)			−0.01 (1.30)		
7–9	75 (17.3)	0.14 (1.13)			−0.11 (1.13)		
HIV related							
Born with HIV *n* (%)			*t* (422) = 0.26	0.792		*t* (13.6) < 0.01	1.000
No	14 (3.2)	0.09 (1.46)			−0.01 (1.56)		
Yes	410 (96.7)	0.00 (1.27)			−0.01 (1.22)		
Nadir CD4 count *n* (%)			*F* (3, 399) = 0.98	0.402		*F* (3, 399) = 0.67	0.572
<200	81 (20.1)	−0.06 (1.35)			0.07 (1.47)		
200–349	73 (18.1)	0.08 (1.24)			0.07 (1.25)		
350–499	71 (17.6)	−0.26 (1.10)			−0.16 (0.91)		
500+ cells/mm^3	178 (44.2)	−0.02 (1.27)			−0.08 (1.22)		
Current CD4 count *n* (%)			*F* (3, 430) = 1.02	0.382		*F* (3, 430) = 1.77	0.152
<200	26 (6.0)	0.15 (1.47)			0.24 (1.16)		
200–349	49 (11.3)	0.05 (1.55)			0.24 (1.38)		
350–499	69 (15.9)	0.22 (1.10)			0.13 (0.97)		
500+ cells/mm^3	290 (66.8)	−0.06 (1.24)			−0.09 (1.24)		
WHO HIV clinical stage *n* (%)			*F* (3, 437) = 3.83	0.010*		*F* (3, 437) = 1.52	0.207
Stage 1	57 (12.9)	−0.12 (1.47)			−0.05 (1.46)		
Stage 2	220 (49.9)	0.05 (1.28)			0.04 (1.17)		
Stage 3	155 (35.1)	−0.11 (1.08)			−0.08 (1.21)		
Stage 4	9 (2.0)	1.29 (1.86)			0.77 (0.76)		
On ART *n* (%)			*t* (439) = 0.22	0.824		*t* (439) = 0.60	0.551
No	25 (5.7)	0.05 (1.58)			0.14 (1.55)		
Yes	416 (94.3)	−0.03 (1.25)			−0.01 (1.20)		
Viral load > 1000 copies/ml[a]			*t* (254) = −0.43	0.667		*t* (254) = −0.29	0.772
No	176 (39.9)	−0.02 (1.30)			−0.03 (1.32)		
Yes	80 (31.3)	0.05 (1.25)			0.02 (1.06)		
Missed any ARV doses *n* (%)			*t* (427) = −1.06	0.288		*t* (427) = −0.34	0.737
No	396 (89.8)	−0.21 (1.17)			−0.06 (1.35)		
Yes	33 (7.7)	0.03 (1.27)			0.01 (1.20)		

TABLE 4 | Continued

		Emotional problems			Behavioral problems		
Variable	**Total sample**	**Std difference score**	**Test statistic**	***p* value**	**Std difference score**	**Test statistic**	***p* value**
		M (SD)			**M (SD)**		
Caregiver characteristics							
Gender *n* (%)			*t* (439) = 0.02	0.986		*t* (439) = −1.67	0.097
Female	355 (80.5)	0.00 (1.28)			−0.05 (1.21)		
Male	86 (19.5)	−0.00 (1.20)			0.20 (1.26)		
Age M (SD)	41.58 (11.95)		*r* = −0.10	0.036*		*r* = −0.42	0.381
Caregiver interviewed *n* (%)			*F* (3, 437) = 2.06	0.105		*F* (3, 437) = 1.23	0.297
Mother	191 (43.3)	−0.03 (1.31)			−0.10 (1.20)		
Father	46 (10.4)	−0.22 (1.03)			−0.05 (0.91)		
Grandparent	62 (14.1)	−0.19 (1.01)			−0.02 (1.07)		
Other	142 (32.2)	1.94 (1.36)			0.16 (1.39)		
Employed *n* (%)			*t* (74.8) = −1.57	0.121		*t* (439) = −2.10	0.036*
No	62 (14.1)	−0.27 (1.50)			−0.30 (1.49)		
Yes	379 (85.9)	0.04 (1.22)			0.05 (1.17)		
HLOE *n* (%)			*F* (3, 435) = 5.14	0.002*		*F* (3, 435) = 1.74	0.159
No formal education	42 (9.6)	−0.34 (0.97)			0.01 (1.17)		
Primary education	196 (44.6)	−0.13 (1.13)			−0.08 (1.12)		
Secondary education	140 (31.9)	0.06 (1.37)			−0.03 (1.25)		
Tertiary education	61 (13.9)	0.50 (1.50)			0.32 (1.46)		
Marital status *n* (%)			*F* (3, 437) = 1.21	0.304		*F* (3, 437) = 0.82	0.482
Cohabiting	229 (51.9)	−0.03 (1.24)			0.02 (1.26)		
Widowed	109 (24.7)	−0.05 (1.35)			−0.06 (1.15)		
Separated	47 (10.7)	−0.10 (1.20)			−0.16 (1.10)		
Single	56 (12.7)	0.30 (1.28)			0.19 (1.33)		
Carer of other children *n* (%)			*t* (439) = −1.99	0.047*		*t* (439) = −1.75	0.080
No	82 (18.6)	−0.25 (1.10)			−0.21 (1.10)		
Yes	359 (81.4)	0.06 (1.30)			0.05 (1.25)		
Caregiver HIV positive *n* (%)			*t* (435) = 0.63	0.530		*t* (435) = 1.97	0.049*
No	196 (44.4)	0.05 (1.28)			0.13 (1.31)		
Yes	241 (55.1)	−0.02 (1.24)			−0.10 (1.15)		
Caregiver health status *n* (%)			*t* (439) = 1.55	0.123		*t* (439) = 0.62	0.535
Poor or average	195 (44.2)	0.10 (1.40)			0.04 (1.25)		
Good or very good	246 (55.8)	−0.08 (1.14)			−0.03 (1.20)		
SRQ-20 score ≥ 6 *n* (%)			*t* (87.2) = −2.38	0.020*		*t* (84.1) = −1.18	0.243
No	370 (83.9)	−0.07 (1.2)			−0.04 (1.1)		
Yes	71 (16.1)	0.38 (1.5)			0.20 (1.6)		
SRQ-20 total score M (SD)	2.78 (3.38)		*t* = 0.17	<0.001*		*t* = 0.10	0.045*

[a]Viral load missing for 185 (42.0%) of adolescents.

**Significance set at p < 0.05.*

ART, antiretroviral treatment; BPs, behavioral problems; EPs, emotional problems; HLOE, highest level of education; SRQ-20, Self-Reporting Questionnaire.

Sensitivity Analysis With Discrepancy Scores Based on Averaged Severity Scores

Only results that are different (in terms of a change in statistical significance) from the main results are reported.

Adolescent BPs

Discrepancy scores based on averaged total severity scores were significantly correlated with discrepancy scores using total severity scores ($r = 0.986$, $p < 0.001$). Adolescent age ($B = -0.70$, 95% CI = −0.15; −0.01, $p = 0.098$) was only trend significantly associated with discrepancy scores.

Adolescent EPs

Discrepancy scores based on averaged total severity scores were significantly correlated with discrepancy scores using total severity scores ($r = 0.937$, $p < 0.001$). Discrepancy scores for EPs were significantly associated with adolescent age ($B = -0.11$, 95% CI = −0.20; −0.03, $p = 0.009$) and WHO stage 2 ($B = 0.44$, 95% CI = 0.05; 0.83, $p = 0.026$), such that discrepancy in reporting EPs decreased with advancing adolescent age and caregivers rated EPs as more severe than adolescents if adolescents were in WHO HIV stage 2 as compared to stage 1.

Child EPs

Discrepancy scores based on averaged total severity scores were significantly correlated with discrepancy scores using total severity scores ($r = 0.915$, $p < 0.001$). Child age ($B = -0.10$, 95% CI = −0.20; 0.01, p = 0.063) and caregivers having a primary ($B = 0.40$, 95% CI = −0.03; 0.75, $p = 0.071$) level of education were only trend significantly associated with discrepancy scores.

TABLE 5 | Association of demographic and clinical variables to the standardized difference score for emotional problems between caregivers and children.

Variable	Total sample	Std difference score	Test statistic	*p* value
		M (SD)		
Total sample *n* (%)	488 (100)	0.00 (1.27)		
Child/adolescent characteristics				
Gender *n* (%)				
Female			*t* (486) = 0.11	0.913
Male	256 (52.5)	0.01 (1.29)		
	232 (47.5)	0.00 (1.26)		
Age M (SD)	9.42 (1.09)		*r* = −0.12	0.011*
Missed any school *n* (%)			*t* (472) = 0.21	0.838
No	187 (38.3)	−0.01 (1.11)		
Yes	287 (60.5)	−0.03 (1.33)		
Household characteristics				
Study site *n* (%)			*t* (486) = −1.92	0.056
Rural	255 (52.3)	−0.11 (1.32)		
Urban	233 (47.7)	0.12 (1.22)		
Lives with *n* (%)			*F* (3, 484) = 1.90	0.318
Two parents	144 (29.6)	0.07 (1.39)		
Single parent	191 (39.2)	0.07 (1.23)		
Grandparents	91 (18.7)	−0.21 (1.31)		
Other	61 (12.5)	−0.05 (1.03)		
Food security *n* (%)			*t* (485) = 1.53	0.126
No	101 (20.7)	0.17 (1.36)		
Yes	386 (79.3)	−0.04 (1.25)		
Socioeconomic index *n* (%)			*F* (3, 480) = 0.15	0.927
0–2	83 (17.1)	0.05 (1.30)		
3–4	174 (36.0)	0.02 (1.33)		
5–6	166 (34.3)	0.00 (1.13)		
7–9	61 (12.6)	−0.09 (1.40)		
HIV related				
Born with HIV *n* (%)			*t* (474) = 0.69	0.492
No	10 (2.0)	0.27 (1.44)		
Yes	466 (97.9)	−0.01 (1.26)		
Nadir CD4 count *n* (%)			*F* (3, 449) = 0.32	0.812
<200	57 (12.6)	0.09 (1.48)		
200–349	51 (11.3)	−0.06 (1.37)		
350–499	47 (10.4)	−0.12 (1.60)		
500+ cells/mm3	298 (65.8)	0.05 (1.19)		
Current CD4 count *n* (%)			*F* (3, 482) = 0.92	0.433
<200	26 (5.3)	−0.26 (1.23)		
200–349	14 (2.8)	−0.31 (0.93)		
350–499	38 (7.8)	0.17 (1.44)		
500+ cells/mm3	408 (84.0)	0.02 (1.26)		
WHO HIV clinical stage *n* (%)			*F* (3, 484) = 2.84	0.037*
Stage 1	74 (15.2)	0.12 (1.14)		
Stage 2	275 (56.4)	0.08 (1.22)		
Stage 3	131 (26.8)	−0.27 (1.41)		
Stage 4	8 (1.6)	0.44 (1.57)		
On ART *n* (%)			*t* (466) = 0.54	0.587
No	469 (96.1)	0.16 (0.97)		
Yes	19 (3.9)	−0.01 (1.28)		
Viral load > 1000 copies/ml			*t* (466) = 0.24	0.808
No	116 (24.8)	0.02 (1.26)		
Yes	352 (72.1)	−0.01 (1.33)		
Disclosed HIV status *n* (%)			*t* (486) = 0.18	0.986
No	274 (56.1)	0.00 (1.31)		
Yes	214 (43.9)	−0.00 (1.23)		
Caregiver characteristics				
Gender *n* (%)			*t* (486) = −0.01	0.996
Female	413 (84.6)	−0.00 (1.29)		
Male	75 (15.4)	0.00 (1.21)		
Age M (SD)	39.6 (11.7)		*r* = −0.12	0.011*
Caregiver interviewed *n* (%)			*F* (3, 484) = 1.97	0.118
Mother	270 (55.3)	0.09 (1.29)		

TABLE 5 | Continued

Variable	Total sample	Std difference score	Test statistic	p value
		M (SD)		
Father	49 (10.0)	−0.06 (1.32)		
Grandparent	68 (13.9)	−0.33 (1.33)		
Other	101 (20.7)	0.02 (1.14)		
Employed n (%)			t (486) = 0.48	0.633
No	73 (15.0)	0.66 (1.42)		
Yes	415 (85.0)	−0.01 (1.25)		
HLOE n (%)			F (3, 484) = 4.37	0.005*
No formal education	47 (9.6)	−0.46 (1.28)		
Primary education	249 (51.0)	−0.08 (1.21)		
Secondary education	153 (31.4)	0.20 (1.35)		
Tertiary education	39 (8.0)	0.28 (1.17)		
Marital status n (%)			F (3, 484) = 0.38	0.770
Cohabiting	250 (51.2)	0.05 (1.27)		
Widowed	83 (17.0)	−0.06 (1.43)		
Separated	91 (18.6)	−0.09 (1.13)		
Single	64 (13.1)	0.00 (1.27)		
Carer of other children n (%)			t (484) = −0.75	0.453
No	67 (13.7)	−0.11 (1.30)		
Yes	419 (86.2)	0.02 (1.27)		
Caregiver HIV positive n (%)			t (474) = −1.62	0.105
No	134 (27.5)	−0.15 (1.14)		
Yes	342 (71.8)	0.06 (1.30)		
Caregiver health status n (%)			t (485) = 2.01	0.045*
Poor or average	247 (50.7)	0.11 (1.33)		
Good or very good	240 (49.3)	−0.12 (1.20)		
SRQ-20 score ≥ 6 n (%)			t (140.5) = −3.74	<0.001*
No	382 (78.3)	−0.13 (1.2)		
Yes	106 (21.7)	0.47 (1.5)		
SRQ-20 total score M (SD)	3.25 (3.51)		r = 0.22	<0.001*

**Significance set at $p < 0.05$.*

ART, antiretroviral treatment; HLOE, highest level of education; SRQ-20, Self-Reporting Questionnaire.

TABLE 6 | Linear regression of factors associated with discrepancy in the presence of behavioral problems between caregivers and adolescents.

Variable	B (95% CI)	β	p value
Model 1			
Constant	0.78 (−0.45; 2.01)		0.214
Adolescent age	−0.09 (−0.17; −0.01)	−0.10	0.037*
Adolescent male	0.11 (−0.12; 0.34)	0.04	0.356
Caregiver male	0.18 (−0.12; 0.47)	0.06	0.240
Carer other children	0.24 (−0.05; 0.53)	0.08	0.107
Caregiver employed	0.33 (0.00; 0.67)	0.10	0.049*
Caregiver HIV positive	−0.26 (−0.50; −0.02)	−0.10	0.032*
Model 2			
Constant	0.61 (−0.63; 1.84)		0.334
Adolescent age	−0.08 (−0.16; −0.00)	−0.10	0.049*
Adolescent male	0.13 (−0.10; 0.36)	0.05	0.264
Caregiver male	0.20 (−0.10; 0.49)	0.06	0.187
Carer other children	0.25 (−0.05; 0.54)	0.08	0.099
Caregiver employed	0.33 (0.00; 0.66)	0.10	0.049*
Caregiver HIV positive	−0.29 (−0.53; −0.06)	−0.12	0.014*
Experienced HIV stigma	−0.11 (−0.39; 0.18)	−0.03	0.463
SRQ-20 total score	0.04 (0.01; 0.08)	0.12	0.011*

Model 1: F (6, 403) = 3.17 (p = 0.005), R^2 = 0.042.*

Model 2: F (8, 428) = 3.28 (p = 0.001), R^2 = 0.058; R^2 change = 0.015 (p = 0.031*).*

**Significance set at $p < 0.05$.*

B, the unstandardized regression coefficient or beta; β, the standardized beta; SRQ-20, Self-Reporting Questionnaire.

DISCUSSION

To the best of our knowledge, this is the first study to examine the clinical correlates of informant discrepancy for EBPs among CA-HIV. Older adolescents rated their BPs more severely than their caregivers, whereas caregivers who were employed and HIV negative rated BPs as being more severe than adolescents self-rated. Caregivers rated EPs as more severe than adolescents if the adolescents had WHO HIV stage 4 as compared to stage 1, if the caregiver was also caring for other children, and if the caregiver had a tertiary level of education as compared to no formal education. In the child sample, younger children and older caregivers rated EPs as more severe than their counter informants did. Caregivers rated EPs as more severe than children self-rated if the caregiver's self-reported health status was poor, and if they had any level of education as compared to no formal education. Informant discrepancy of EBPs was also associated with HIV stigma experienced by adolescents and caregiver psychological distress. Adolescents who reported experiencing HIV-related stigma in the prior year rated their EPs, but not BPs, as more severe than their caregivers rated. Caregivers with greater psychological distress rated all EBPs as more severe than CA-HIV, especially EPs. In summary, caregiver and CA-HIV discrepancy was associated with sociodemographic

TABLE 7 | Linear regression of factors associated with discrepancy in the presence of emotional problems between caregivers and adolescents.

Variable	*B* (95% CI)	β	*p* value
Model 1			
Constant	0.60 (–0.77; 1.97)		0.393
Adolescent age	–0.09 (–0.17; 0.00)	–0.10	0.054
Adolescent male	0.10 (–0.14; 0.34)	0.04	0.423
Urban environment	0.03 (–0.23; 0.29)	0.01	0.827
WHO HIV stage 2[a]	0.31 (–0.08; 0.70)	0.12	0.117
WHO HIV stage 3[a]	0.20 (–0.20; 0.60)	0.08	0.325
WHO HIV stage 4[a]	1.47 (0.59; 2.35)	0.17	0.001*
Caregiver age	–0.01 (–0.02; 0.00)	–0.07	0.170
Carer other children	0.32 (0.02; 0.62)	0.10	0.038*
Caregiver HLOE primary[b]	0.16 (–026; 0.58)	0.06	0.447
Caregiver HLOE secondary[b]	0.29 (–0.15; 0.72)	0.10	0.203
Caregiver HLOE tertiary[b]	0.77 (0.26; 1.27)	0.21	0.003*
Model 2			
Constant	0.41 (–0.95; 1.76)		0.555
Adolescent age	–0.08 (–0.16; 0.00)	–0.10	0.057
Adolescent male	0.13 (–0.14; 0.34)	0.05	0.278
Urban environment	–0.11 (–0.37; 0.15)	–0.04	0.419
WHO HIV stage 2[a]	0.35 (–0.03; 0.73)	0.14	0.068
WHO HIV stage 3[a]	0.20 (–0.19; 0.60)	0.08	0.305
WHO HIV stage 4[a]	1.50 (0.64; 2.37)	0.17	0.001*
Caregiver age	–0.01 (–0.02; 0.00)	–0.06	0.186
Carer other children	0.30 (–0.03; 0.73)	0.09	0.057
Caregiver HLOE primary[b]	0.16 (–0.18; 0.64)	0.09	0.276
Caregiver HLOE secondary[b]	0.29 (–0.05; 0.81)	0.14	0.086
Caregiver HLOE tertiary[b]	0.77 (0.32; 1.31)	0.22	0.001*
Experienced HIV stigma	–0.37 (–0.67; –0.08)	–0.12	0.012*
SRQ-20 total score	0.07 (0.03; 0.10)	0.18	<0.001*

Model 1: F (11, 423) = 3.69 ($p < 0.001$), R^2 = 0.087. 11*
Model 2: F (13, 421) = 4.79 ($p < 0.001$), R^2 = 0.129; R^2 change = 0.041 ($p < 0.001$*).*
**Significance set at $p < 0.05$*
[a]WHO stage 1 was the WHO HIV stage category against which other WHO stage categories were analyzed.
[b]No formal education was the education category against which other education categories were analyzed.
B, the unstandardized regression coefficient or beta; β, the standardized beta; HLOE, highest level of education; SRQ-20, Self-Reporting Questionnaire.

TABLE 8 | Linear regression of factors associated with discrepancy on the presence of emotional problems between caregivers and children.

Variable	*B* (95% CI)	β	*p* value
Model 1			
Constant	1.58 (0.42; 2.74)		0.008*
Child age	–0.16 (–0.26; –0.06)	–0.14	0.003*
Child male	0.03 (–0.19; 0.25)	0.01	0.784
Urban environment	0.09 (–0.15; 0.34)	0.04	0.461
WHO HIV stage 2[a]	0.05 (–0.29; 0.39)	0.02	0.793
WHO HIV stage 3[a]	–0.27 (–0.64; 0.10)	–0.10	0.151
WHO HIV stage 4[a]	0.48 (–0.44; 1.39)	0.05	0.308
Caregiver age	–0.01 (–0.02; –0.00)	–0.10	0.030*
Caregiver health good	–0.31 (–0.54; –0.08)	–0.12	0.007*
Caregiver HLOE primary[b]	0.43 (0.04; 0.82)	0.17	0.031*
Caregiver HLOE secondary[b]	0.62 (0.21; 1.04)	0.23	0.004*
Caregiver HLOE tertiary[b]	0.80 (0.25; 1.34)	0.17	0.004*
Model 2			
Constant	1.16 (–0.00; 2.32)		0.050
Child age	–0.16 (–0.26; –0.06)	–0.13	0.002*
Child male	0.02 (–0.20; 0.24)	0.08	0.854
Urban environment	0.02 (–0.22; 0.27)	0.04	0.863
WHO HIV stage 2[a]	0.07 (–0.26; 0.41)	0.03	0.676
WHO HIV stage 3[a]	–0.23 (–0.60; 0.14)	–0.08	0.216
WHO HIV stage 4[a]	0.34 (–0.56; 1.25)	0.03	0.455
Caregiver age	–0.01 (–0.02; 0.00)	–0.08	0.079
Caregiver health good	–0.13 (–0.37; 0.11)	–0.05	0.273
Caregiver HLOE primary[b]	0.44 (0.05; 0.82)	0.17	0.025*
Caregiver HLOE secondary[b]	0.66 (0.25; 1.08)	0.24	0.002*
Caregiver HLOE tertiary[b]	0.83 (0.30; 1.37)	0.18	0.002*
SRQ-20 total score	0.07 (0.04; 0.10)	0.19	<0.001*

Model 1: F(11,474) = 3.81 ($p < 0.001$), R^2 = 0.081.*
Model 2: F(12,473) = 4.90 ($p < 0.001$), R^2 = 0.110; R^2 change = 0.029 (*$p < 0.001$).*
**Significance set at $p < 0.05$.*
[a]WHO stage 1 was the WHO HIV stage category against which other WHO stage categories were analyzed.
[b]No formal education was the education category against which other education categories were analyzed.
B, the unstandardized regression coefficient or beta; β, the standardized beta; HLOE, highest level of education; SRQ-20, Self-Reporting Questionnaire.

features of the CA-HIV and their caregivers, HIV disease-related factors, HIV stigma, and caregiver psychological distress and associations varied between EPs and BPs.

Similar to other settings, CA-HIV in this study frequently endorsed experiencing EBPs, with 14.5% of adolescents self-reporting BPs, 28.8% self-reporting EPs, and 36.9% of the children self-reporting EPs. These rates are comparable to what has been found in other studies globally (9, 10, 16, 23, 70). An earlier Ugandan study among HIV-positive adolescents documented higher rates of self-reported psychological distress (51.2%) and substance use (6.1%) (14); however, the adolescents had more advanced HIV and were not receiving ART. Also, in that study, adolescents aged between 13 and 18 years were more likely to be psychologically distressed than those between 10 and 12 years, whereas in our study, rates of self-reported EPs were higher in children than in adolescents. Among CA-HIV, similar to other settings, comorbidity of mental health problems is common (13, 71). In our sample, comorbidity was also frequently reported with 44.0% of adolescents and 42.9% of children with EBPs, endorsing two or more conditions.

Based on previous research with child and adolescent samples, we expected that caregiver and youth agreement would be modest (5, 32, 36, 37). We found generally low agreement between caregivers and CA-HIV, based on symptom severity and symptom count cutoff scores. Although caregiver–adolescent agreement was lower than demonstrated in the YI-4 validation study, it was similar to caregiver–youth agreement in another sample of CA-HIV (7, 33). Agreement between caregivers and children was also of a similar magnitude to the aforementioned study that employed the CI-4 (7). We thus demonstrated similarly low agreement between caregivers and CA-HIV to what has been found in other settings. Meta-analyses have revealed that generally there is greater caregiver–child agreement for externalizing than for internalizing symptoms (32, 37). Similarly, we found that agreement between caregivers and adolescents about the presence of EBPs was significant for BPs, but not EPs. Agreement between caregivers and children regarding the presence of EPs was also significant, suggesting greater agreement between caregivers and children, than between caregivers and adolescents. An earlier meta-analysis also revealed greater agreement between caregivers and younger children, than between caregivers and adolescents, although this association was not demonstrated in a more recent meta-analysis (32, 37). A longitudinal study that evaluated multi-informant reports from childhood into adulthood also found that the agreement between caregiver and youth self-report for internalizing problems decreased as individuals became older, whereas agreement regarding externalizing problems increased with age (36).

It is interesting to note that, in our sample, contrary to our hypothesis, caregivers reported higher rates of EPs than CA-HIV and adolescents self-reported higher rates of BPs than their caregivers. Across various societies, adolescents tend to rate more, and more severe, problems, both internalizing and externalizing, than their caregivers do (36, 51). Other studies of HIV-affected youth have found that caregivers reported more BPs than self-reported by youth (72, 73), and youth reported higher rates of EPs than caregivers (16, 73). Although caregivers reported higher rates of EPs, CA-HIV reported significantly higher rates of SAD, which could be related to context, with SAD occurring in situations where caregivers are often not present; in addition, the internal experience of certain anxiety symptoms may not be evident to caregivers. Generally, agreement has been demonstrated to be higher for observable symptoms than for unobservable symptoms (38). Adolescents also reported higher rates of substance use and conduct problems, which again could reflect the context in which these behaviors occur, as well as adolescents hiding certain unfavorable behaviors from their caregivers. The setting in which discrepancy is being evaluated can also influence the association; for instance, one study found that among clinical samples, both parent- and youth-reported EPs were associated with clinician diagnoses of EPs, but among community samples, only youth self-reported EPs were associated with clinician diagnoses, whereas only parent-reported BPs were associated with clinician diagnoses of BPs among both community and clinic samples (74).

Discrepancy in EP severity ratings decreased with increased child and caregiver age and decreased with increased adolescent age for BPs. Similar to our results, other studies have also found that discrepancies in child BPs decreased with advancing child age (68). The effect of child age on agreement between caregiver and child have, however, been inconsistent and may be related to differences in approach (38). We found that when averaged severity scores were used, associations between discrepancy and child age for EPs, and adolescent age for BPs were no longer significant, whereas adolescent age was significantly associated with discrepancy for EPs. Thus, overall, older CA-HIV rated their EBPs as more severe than caregivers rated them, but this association was of a small magnitude.

Caregivers rated BPs as less severe than adolescents if they themselves were HIV positive or were unemployed. Caregivers rating BPs as less severe than adolescents may reflect caregivers being unaware of adolescent behaviors occurring in contexts outside of the home environment. Parents who are unemployed and HIV positive may be dealing with their own stressors and thus may be less aware of other difficulties faced by adolescents. A systematic review evaluating the effects of HIV-infected caregivers on children in Sub-Saharan Africa reported on a number of studies that noted an association between caregiver HIV and increased EBPs (75). Of note, an earlier Ugandan study found that increased CA-HIV psychological distress was associated with the caretaker being HIV negative (14). Thus, the effect of caregiver HIV status may vary according to the youth's own status.

Educational attainment of caregivers was associated with increased discrepancy in severity ratings for EPs in both the child and adolescent samples. Caregivers with primary, secondary, or tertiary HLOE rated child EPs as more severe than caregivers with no formal education. In the adolescent sample, this association was demonstrated only for those who had attained a tertiary HLOE as compared to no formal education. In line with these results, a study of CA-HIV found that family characteristics (including caregiver HLOE), largely, were associated with caregiver-rated EBPs, but not with youth self-rated EBPs (7). In contrast, a study of an adolescent forensic sample found that caregiver education had no effect on discrepancy of EBPs (76). An opposite association was demonstrated in a Taiwanese study, where investigators used parental level of education as a proxy of socioeconomic status (SES), and found that parents rated EBPs as less severe than youths if the father had completed tertiary education as compared to not completing secondary education (40). Beyond SES, educational attainment of caregivers may reflect caregiver health/mental health literacy and thus their awareness of EPs.

Adolescents who had attained a WHO HIV stage 4, as compared to stage 1, rated their EPs as less severe than their caregivers did, and when averaged severity scores were used, this was also demonstrated for WHO HIV stage 2. Caregivers of adolescents who had attained a more advanced clinical HIV status may be more concerned about the adolescent's health status overall due to previous significant health problems. Some studies have demonstrated that more advanced HIV disease may be linked to EBPs in CA-HIV. One study in 81 adolescents found that having a past Centers for Disease Control and Prevention (CDC) class C diagnosis was associated with having at least one prior psychiatric disorder diagnosis and having received prior mental health treatment (18). Another US study of 274 clinically stable CA-HIV found that those with CD4 counts in the lower 50% (<660 cells/mm^3) were more likely to have caregiver-reported conduct problems (17). In a Malawian study of 562 adolescents, self-rated depression severity was also associated with more severe immunosuppression (based on CD4 count) (19).

Similar to our research, other studies have also found that discrepancies were not related to who the caregiver was (42, 77), although most studies evaluating informant discrepancies have included the mother as caregiver (38). In our sample, caregivers who were also caring for other children rated adolescent EPs as more severe than the adolescents themselves, and caregivers who rated their own general health status lower rated child EPs as more severe than children themselves. Caregivers caring for multiple children may have a higher burden of care, and caregivers with poorer overall health status may also face increased stressors that influence their ratings of CA-HIV mental health status. A study from New York in CA-HIV, aged between 7 and 16 years, utilizing structural equation modeling (SEM), found that caregiver–child stress (including factors such as parent–child relationship problems, caregiver mental health problems, and stressful or negative life events) was associated with both CA-HIV self-reported and caregiver-reported EBPs (78). Other studies have also demonstrated that parents reporting increased caregiving stress rated EBPs as more severe than their children self-reported (42, 76). When caregiver psychological distress was controlled for, however, neither caring for other children nor self-rated health status remained significantly associated with informant discrepancy.

Adolescents who reported experiencing HIV-related stigma in the prior year rated EPs, but not BPs, as more severe than their caregivers did. Of note, when the setting where stigma had been experienced was evaluated, this association was significant for stigma occurring only within the home environment. Other studies in Ugandan adolescents have also demonstrated that HIV-related stigma was associated with increased self-rated mental health problems (27, 29). Adolescents experiencing HIV stigma may develop more EPs; alternatively, adolescents with EPs may interpret events as stigmatizing. Studies have suggested that the pathway between HIV stigma experienced in the community and mental health and adherence outcomes is mediated through internalized stigma (e.g., negative self-views related to HIV) (79). The fact that discrepancy between caregivers and adolescents on EPs was demonstrated largely for stigma experienced in the home environment suggests that familial relational problems may be playing a role in discrepancy, with caregivers not aware of how adolescents are experiencing the home environment as well as the EPs they contend with.

Increased severity of caregiver psychological distress was associated with caregivers rating EPs and BPs as more severe than adolescents self-rated. The association was stronger for EPs than BPs and psychological distress ratings suggestive of possible depression in caregivers was also associated with increased discrepancy of EPs, but not BPs, on bivariate analysis. Our findings are consistent with the majority of the literature (38, 40, 41), although some studies have found that caregiver self-reported mood symptoms were not associated with discrepancy (42). Studies have also demonstrated that maternal anxiety, but not depression, was significantly associated with discrepancy, such that anxious mothers rated their child's anxiety as more severe than children themselves (80). The SRQ-20 includes symptoms of both anxiety and depression, and we assessed for discrepancy in the severity of CA-HIV EPs combined and thus cannot comment on possible differential associations for anxiety and depression. Increased reporting of EBPs in their children by mothers with depression have been postulated to be due to possible distortion, with depressed mothers over-reporting EBPs, or to reflect accuracy, such that children of depressed mothers have more EBPs and mothers are accurately reporting on those (81). One study found that parental psychological distress was associated with increased parental report of BPs and EPs as well as increased EPs according to parental and child report combined, thus suggesting that parental psychopathology is associated with both increased child EPs and with possible over-reporting of EBPs by parents (82). Regardless of whether discrepancy is due to distortion or an accurate reflection of CA-HIV EBPs, the discrepancy demonstrated still highlights the need for multi-informant reports (41).

Strengths and Limitations

One of the strengths of the study is the relatively large sample of CA-HIV from a region with a high HIV prevalence. It also includes youth self-report, which is often not assessed in CA-HIV studies, providing unique information on context and how CA-HIV view their own EBPs. This study also considered a broader range of sociodemographic variables than has typically been evaluated in studies examining discrepancy. The assessment instruments adopted for this study were previously used in a large-scale study of CA-HIV from the US (7), thus facilitating cross-cultural comparisons. These measures are also well suited to assess informant agreement as they were designed to have corresponding items and are scored in a similar fashion. Meta-analyses indicate that informant agreement is best evaluated by measures that share the same content, item labeling and scaling (32).

This study also has some notable limitations. We utilized a cross-sectional research design and as such could not determine cause-and-effect relationships. The EBPs reported by caregivers and CA-HIV were not confirmed with a clinical interview, and thus we cannot comment on specificity and sensitivity in this sample. The sample included differed from the sample excluded, and this may have influenced results. Adolescents who were older, living in urban areas, who had a higher socioeconomic index, with caregivers interviewed who were employed and who were not their parents or grandparents were more likely to be excluded. The main reasons these participants were excluded was that caregivers did not complete the CASI-5, and within this context, the differences could be explained by caregivers who were likely unable to complete the assessment as they were working, and that older adolescents were more likely to attend appointments unaccompanied. Children who were residing in urban areas, had a WHO clinical stage 1 or 2, with caregivers interviewed who were younger and HIV negative were more likely to be excluded. The age discrepancy with caregivers is likely due to excluding caregivers who were not older than 17 years; the reasons for the other differences are less apparent. We grouped EBPs together into broad constructs when assessing discrepancy and thus cannot comment on factors associated with discrepancy for individual disorders. The approach we used to determine overall severity of BP and EPs may also have implications. We used total severity scores obtained for disorders to compute discrepancy scores, which may have weighted total severity towards disorders with more symptoms. However, sensitivity analysis with discrepancy scores determined with averaged severity scores mostly provided the same results, with some differences noted. The differences were of a small magnitude, such that significant associations became trend significant and vice versa. The strength of association for the factors that differed according to approach used to determine severity scores was thus likely small. Future studies can perform more in-depth analysis evaluating agreement and discrepancy for individual disorders as it is beyond the scope of this manuscript. Although we noted receipt of ART, data were not collected on specific ARV regimens. Lastly, we did not correct for multiple comparisons (and type I error) and thus our results should be considered exploratory.

Conclusions

Similar to other studies, we demonstrate that CA-HIV commonly experience EBPs, whether based on caregiver or youth self-report. Furthermore, CA-HIV may be prone to develop more severe psychopathology as reflected by higher rates of psychiatric hospitalizations and increased rates of prior psychotropic and behavioral treatments (35, 83). Mental health problems can have serious detrimental consequences in individuals with HIV; for instance, higher mortality rates were reported for HIV-infected individuals with comorbid psychiatric and substance use disorders than those without (84). In the aforementioned study, the mortality risk was lower in those who had received treatment for EBPs, highlighting the importance of screening and timely intervention. Although mental health outcomes have not always been linked to adherence problems in individual studies, a systematic review identified mental health as a factor influencing adherence, particularly when other risk factors are also present (85). Despite the burden of mental health problems in CA-HIV, there is a dearth of appropriate mental health services, especially in resource-limited settings (15).

To our knowledge, this is the first study to evaluate informant discrepancy of EBPs in CA-HIV. Discrepancy between caregivers and CA-HIV was greater if caregivers were unemployed and had no formal education. These results suggest that socioeconomic status may influence the discordance between caregivers and CA-HIV regarding the presence of EBPs. Although many studies have not found an association between socioeconomic status and informant discrepancies, a meta-analysis demonstrated that agreement between mothers and fathers on internalizing and externalizing problems was lower for children of low socioeconomic status (38, 86). Of note, some HIV-related variables were associated with discrepancy (i.e., caregivers rating more severe BPs than adolescents if they were HIV negative and more severe EPs if the child had a history of more advanced clinical HIV). These findings suggest that HIV disease-related factors may influence caregiver CA-HIV discrepancy regarding EBPs. HIV stigma was associated with discrepancy, yet again highlighting the negative impact of HIV stigma as well as the importance of the context in which it is experienced. In addition to HIV-related stigma, mental-health-related stigma can be another barrier to CA-HIV receiving mental health care (15). We assessed only for adolescent perceived interpersonal HIV stigma, and future investigations utilizing broader constructs related to stigma, such as internalized HIV stigma, HIV disclosure stigma, stigma in health care services, mental health stigma, and stigma experienced by caregivers, are warranted. Consistent with prior research (38, 40, 41), we also demonstrated that caregivers with increased psychological distress rate the EBPs of CA-HIV as more severe than youths self-rated.

Informant discrepancies have been linked to poorer youth outcomes (42, 43). Fewer discrepancies between caregivers and youths predict improved treatment engagement and outcomes (44, 87, 88). Informant discrepancy can, therefore, be considered in treatment planning and may contribute to improved treatment outcomes, further highlighting the value of evaluating informant discrepancy in CA-HIV (42, 89). Our study supports the general consensus that mental health screening and assessments, including CA-HIV self-report, should be integrated into routine care and multilevel psychosocial and family-based interventions are needed to support CA-HIV and their caregivers (9).

ETHICS STATEMENT

The study was conducted in accordance with the Declaration of Helsinki and ethical approval was obtained from the Uganda Virus Research Institute's Research and Ethics Committee, the Ethics Committee of the London School of Hygiene and Tropical Medicine, and the Uganda National Council of Science and Technology. Eligible study participants provided written informed consent (caregiver) and assent (CA-HIV) after explanation of the study objectives and procedures. No CA-HIV were enrolled without their assent and all participants were informed that they could withdraw without prejudice at any time. In the majority of cases, the parents provided informed consent for participation of the CA-HIV, but in cases where the primary caregivers were not parents, the guardians of the CA-HIV provided the informed consent.

AUTHOR CONTRIBUTIONS

EK, JL, KG, and VP contributed to the concept and design of the study. Data collection was done by EK, JL, and RM. LH performed statistical data analysis and wrote the paper. All authors contributed to revising the manuscript and have read and approved the submitted version.

FUNDING

This work was supported by an MRC/DFID African Leadership Award to Eugene Kinyanda, Number MR/L004623/1. Leigh van den Heuvel was supported in this work by a NIH-Fogarty Project Titled: "Pittsburgh-Stellenbosch University AIDS-comorbidities Training Research Programme (Pitt-SU AICoTRP; Award to Jean B. Nachega and Soraya Seedat)" and her work reported herein was made possible through funding by the South African Medical Research Council through its Division of Research Capacity Development under the SAMRC

CLINICIAN RESEARCHER (M.D PHD) SCHOLARSHIP PROGRAMME from funding received from the South African National Treasury. The content hereof is the sole responsibility of the authors and do not necessarily represent the official views of the SAMRC or the funders. Soraya Seedat is supported by the South African Research Chairs Initiative in PTSD funded by the Department of Science and Technology and the National Research Foundation.

Funders have played no role in the study design, data collection, analysis, and interpretation and in writing the manuscript.

ACKNOWLEDGMENTS

We would like to acknowledge the work and support provided by the staff of the Mental Health Project at the MRC/UVRI Uganda Research Unit. We would also like to acknowledge the support and cooperation of children/adolescents, caregivers, and management of The AIDS Support Organisation (TASO) clinic (Masaka), Kitovu Mobile AIDS organisation (Masaka), The Uganda Cares clinic (Masaka), Joint Clinical Research Centre clinic (Kampala), and Nsambya Home Care Department (Kampala).

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Conflict of Interest Statement: KG is a shareholder in Checkmate Plus and publisher of the CASI-5, YI-4, and CI-4.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer JA declared a shared affiliation, with no collaboration, with one of the authors JN to the handling editor.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 28 August 2019
doi: 10.3389/fpsyt.2019.00542

Creating Evidence-Based Youth Mental Health Policy in Sub-Saharan Africa: A Description of the Integrated Approach to Addressing the Issue of Youth Depression in Malawi and Tanzania

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Edited by:
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Specialty section:
This article was submitted to
Child and Adolescent Psychiatry,
a section of the journal
Frontiers in Psychiatry

Received: 04 April 2019
Accepted: 12 July 2019
Published: 28 August 2019

Citation:
Kutcher S, Perkins K, Gilberds H, Udedi M, Ubuguyu O, Njau T, Chapota R and Hashish M (2019) Creating Evidence-Based Youth Mental Health Policy in Sub-Saharan Africa: A Description of the Integrated Approach to Addressing the Issue of Youth Depression in Malawi and Tanzania. Front. Psychiatry 10:542. doi: 10.3389/fpsyt.2019.00542

Addressing depression in young people is a health-care policy need in sub-Saharan Africa. There exists poor mental health literacy, high levels of stigma, and weak capacity at the community level to address this health-care need. These challenges are significant barriers to accessing mental health care for depression, soon to be the largest single contributor to the global burden of disease. We here describe an innovative approach that addresses these issues simultaneously while concurrently strengthening key mental health components in existing education and health-care systems as successfully applied in Malawi and replicated in Tanzania. Improving the pathway to care for young people with depression requires the following: improving mental health literacy (MHL) of communities, youth, and teachers; enhancing case identification and linking schools to community health clinics; improving the capacity of community health-care providers to identify, diagnose, and effectively treat depression in youth. Funded by Grand Challenges Canada, we developed and applied a program called "An Integrated Approach to Addressing the Challenge of Depression Among the Youth in Malawi and Tanzania" (IACD). This was an example of, a horizontally integrated pathway to care model designed to be applied in low-resource settings. The model is designed to 1) improve awareness/knowledge of mental health and mental disorders (especially depression) in communities; 2) enhance mental health literacy among youth and teachers within schools; 3) enhance capacity for teachers to identify students with possible depression; 4) create linkages between schools and community health clinics for improved access to mental health care for youth identified with possible depression; and 5) enhance the capacity of community-based health-care providers to identify, diagnose, and effectively treat youth with depression. With the use of interactive, youth-informed weekly radio programs, mental health curriculum training for teachers and peer educators in secondary schools, and a clinical competency training program for community-based health workers, the innovation created a "hub and spoke" model for improving mental health care for young people. Positive results obtained in Malawi and replicated in Tanzania suggest that this approach may provide an effective and potentially sustainable framework for enhancing youth mental health care, thus providing a policy ready framework that can be considered for application in sub-Saharan Africa.

Keywords: adolescent depression, radio, social and behavior change communication, school-based mental health, primary care, low-income country, sub-Saharan Africa

INTRODUCTION

Mental disorders account for the highest burden of disease among young people worldwide, with depression soon poised to become the largest single contributor to the burden of disease globally (1, 2). About 70% of mental disorders can be diagnosed before the age of 25, making the adolescent years a critical time for mental health promotion, early identification, and rapid access to effective mental health care (3–7). If left untreated, depression can contribute to early mortality and increased morbidity and has a significant negative impact on quality of life and future vocational success for young people (8). The economic dividend for early identification and effective treatment of depression in Low and Middle Income Countries (LMICs) is considerable (9).

However, numerous challenges exist that limit rapid access to effective care for young people with depression. While there is a paucity of epidemiological data on the prevalence of depression in young people in sub-Saharan Africa (10, 11), the World Health Organization estimates that approximately 6–8% of young people live with depression (1, 12). While research about youth mental health is scant in Malawi and Tanzania, available studies indicate that depression is a common disorder. Udedi (13) found a prevalence rate of roughly 30% in attendees of the Matawade Health Center in Zomba, and Kauye et al. (14) reported a rate of 19% in attendees of other clinics. In a study of pregnant women and young mothers (many of whom are teenagers), Stewart et al. (15) reported rates of depression ranging between 10.7% and 21.1%. Kim et al. (16) report a depression rate of 20% in adolescents attending HIV/AIDS clinics. In Tanzania, the 2008 Global School-Based Student Health Survey (GSHS) reported that 23.6% of students felt sad, lonely, or hopeless daily, with 11.2% reporting suicidal thoughts (17). Similar rates have been reported in Nigeria (18) and Kenya (19).

Furthermore, Crabb et al. (20) report that there is poor understanding of mental health and mental illness throughout sub-Saharan Africa (SSA), and in many countries in SSA, mental disorders such as depression are often not recognized as an illness and remain largely untreated (20, 21). Numbers of highly trained specialty providers are very low, and availability of effective mental health care in community clinics is limited (6, 14, 22, 23).

Settings

Malawi is a low-income country of about 16 million people in Eastern SSA with annual health spending per capita of about $43.00 and about 2% of the overall health budget spent on mental health services (24, 25). Mental health legislation was revised in 2005. There is no mental health policy, although one is under development. Some community health providers have received limited training in mental health care in the past 5 years and none in youth mental health. The ratio of mental health professionals to population is about 2.5/100,000, with the majority being psychiatric nurses (20).

The United Republic of Tanzania is a low-income country, with about 45 million people in eastern SSA (24–26) currently listed as one of the 49 least-developed countries in the world (Development Policy and Analysis Division, DESA). The total government expenditure on health per capita is $42.00 (27), with mental health expenditures comprising 2.4% of the total health budget (ibid). A mental health policy and plan (2006) is available and currently undergoing revision. Very few primary health-care providers have received training in mental health care and none in youth mental health. Psychiatric nurses provide most of the mental health services with a ratio of 2/100,000 but with limited training in youth mental health. Mental health coordinators with no training in youth mental health are assigned to districts, with 94% of the 121 districts having mental health coordinators (28).

In contrast to the severely limited capacity to meet youth mental health-care needs in Malawi and Tanzania, over 50% of the current population is below 20 years of age (see **Figure 1**). Due to improvements in age of mortality, as this cohort ages, it will bring with it increasing demands for mental health care to a system that is already struggling to meet current needs. Thus, there is urgent need to develop effective and frugal mental health policies, plans, and the capacity to address these needs, as effective interventions in this age group can be expected to show positive results in the present and into the future.

The above considerations identify the need for the development, application, and evaluation of an effective and frugal mental health policy and programmatic framework that can simultaneously improve mental health literacy and enhance capacity for improved access to effective mental health care for young people with depression. The "An Integrated Approach to Addressing the Challenge of Depression Among the Youth in Malawi and Tanzania (IACD)" was designed to meet that need. The IACD innovation promotes the development of an integrated horizontal pathway to mental health care for youth, beginning with enhancing MHL in both the community (through interactive radio programs and other electronic interventions, such as Facebook and WhatsApp) and schools (through teacher training, curriculum MHL resources, and school-based radio-listening clubs). The innovation builds capacity for early identification of

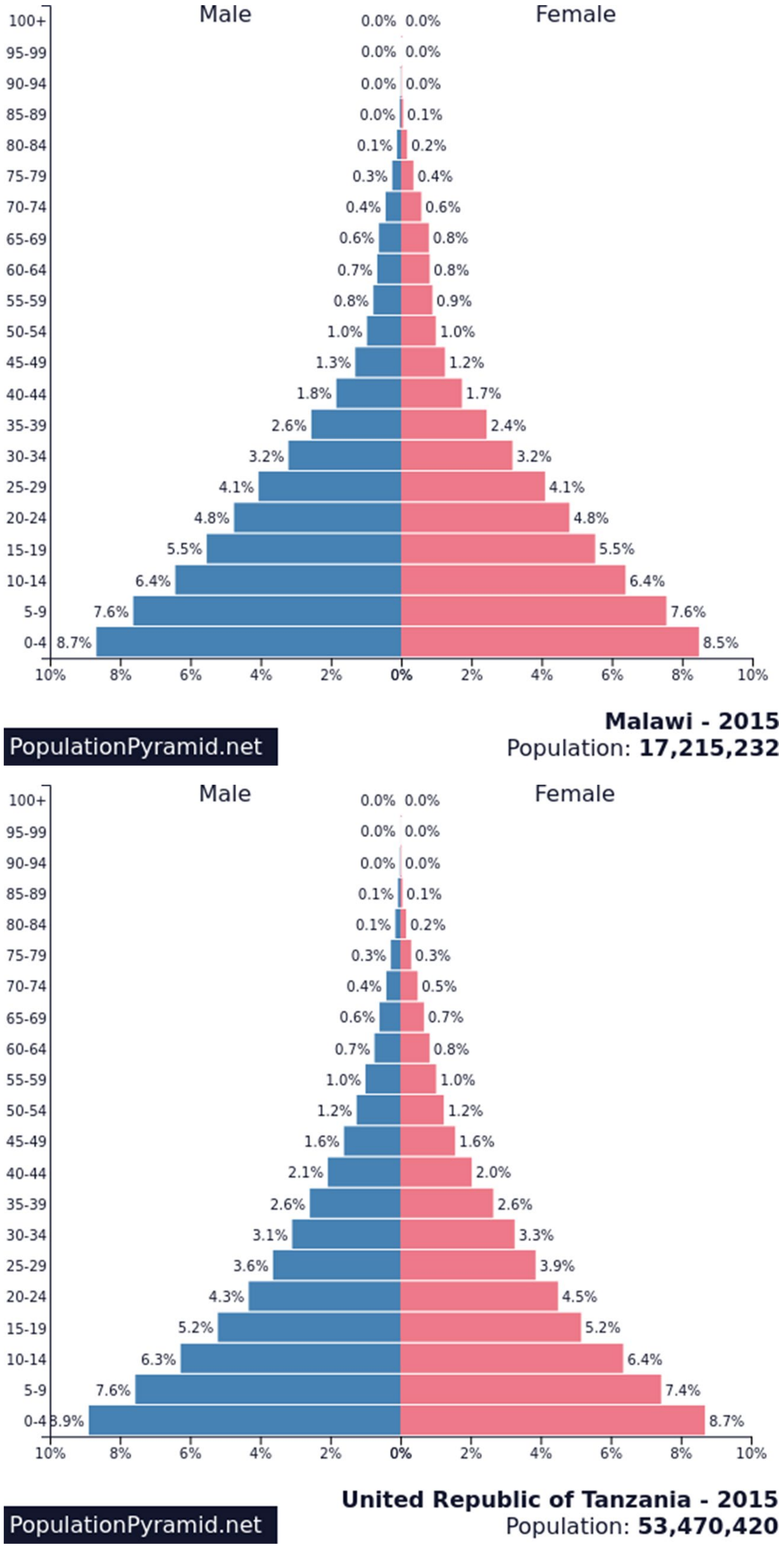

FIGURE 1 | Current population age pyramids: Malawi and Tanzania.

depression by teachers and community health-care providers and links schools to community health clinics to help enhance access to mental health care. Community health-care providers are trained in the identification, diagnosis, and evidence-based treatment for depression in young people. Applied together, these linked components create a pathway to care for youth with depression.

This innovative combination of interactive radio programs, school-based MHL, and community clinic interventions was the result of a cross-disciplinary collaboration between Canadian communications (Farm Radio International) and academic (Dr. Stan Kutcher, Professor of Psychiatry at Dalhousie University, Halifax Canada) expertise. In Malawi, Farm Radio Trust implemented the radio-based activities, and the World University Service of Canada (WUSC) and the Malawi Ministry of Health led the application of training interventions and data collection. In Tanzania, Farm Radio International's Tanzania country office implemented the radio-based activities and provided logistical support for training and research activities supported by the Ministry of Health and Social Welfare.

Visually, this is illustrated in the three-legged stool diagram (see **Figure 2**) where the seat of the stool is the horizontally integrated pathway to youth mental health care and the supporting legs are 1) youth-participant interactive radio programs that address mental health awareness; 2) school-based mental health literacy and capacity building for early identification in schools; and 3) training for community health workers to enhance their ability to diagnose and effectively treat depression in young people.

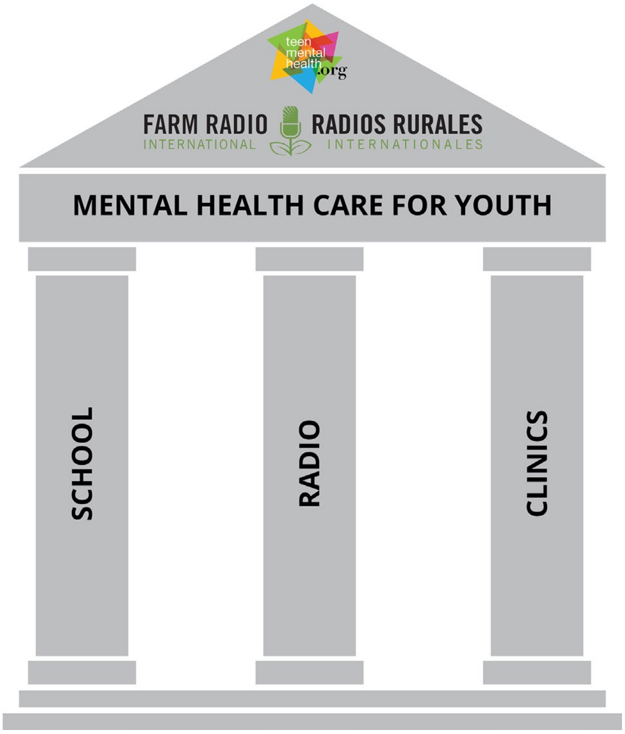

FIGURE 2 | The horizontally integrated pathway for youth mental health care for sub-Saharan Africa.

As this innovation was applied, a variety of research approaches to determine the impact of the various components were used. These included mixed-methods quantitative and qualitative data collection, prospective longitudinal cohort, and cluster controlled designs (see **Table 1**). The interventions were first applied in Malawi and then replicated in Tanzania. This tiered approach addresses the issue of potential scalability of the innovation, as positive results obtained in Malawi and replicated in Tanzania indicate that it is less likely to be nation specific and more likely to be generalizable to multiple settings. The interventions were applied in Central Malawi (Lilongwe, Salima, and Mchinji districts) and in Northern Tanzania (Meru District Centre and Arusha District Centre). All research activities received appropriate ethics approval in their respective jurisdictions.

Mental Health Literacy as a Foundation for Enhancing Mental Health Outcomes (Radio Drama for Community- and Curriculum-Based Approaches for Schools)

Mental health literacy is an important component of health literacy and is essential for improving access to mental health care and reducing stigma related to mental illness (29–35). MHL is foundational for improving mental health outcomes and includes four related components: 1) enhancing capacity to obtain and maintain good mental health; 2) enhancing understanding of mental disorders and their treatments; 3) decreasing stigma related to mental illness; and 4) enhancing help-seeking efficacy (33–35).

Improving MHL can be addressed at both community and institutional levels. In communities, interventions that raise mental health awareness and improve knowledge can be applied. Youth popular mass media (such as radio programs) may provide a useful vehicle for reaching young people in SSA in their communities. Concurrently, enhancing MHL capacity in schools through curriculum embedded resources integrated educational activities) can enhance MHL for both teachers and students alike (35, 36–38).

Enhancing MHL is a component of the Integrated Approach to Addressing the Issue of Youth Depression (IACD) in Malawi and Tanzania. This was achieved in the community by youth-participant interactive radio broadcasts and in schools through teacher training and application of an MHL curriculum resource and school-based radio-listening clubs. Peer mental health educator training was also used in Malawi.

YOUTH-ENGAGING RADIO PROGRAMS

Stigma and lack of awareness about mental disorders are cited as a significant barrier to help seeking in SSA (14, 20, 39). In order to address these issues on a mass scale in communities, we designed and implemented interactive, weekly radio programs that combined radio dramas, quizzes, polls, and "ask the expert" phone-ins.

TABLE 1 | Program designs for radio program, school setting and community healthcare settings implementations.

Radio program	School settings	Community health-care settings
Semi-controlled cluster design cross-sectional comparison—mental health awareness and mental health literacy Prospective controlled cluster design—mental health awareness and mental health literacy	Prospective cohort design—teachers' mental health literacy	Prospective cohort design—provider competencies (knowledge; attitudes; confidence)
	Prospective cohort design—peer educator mental health literacy	Clinical outcomes—screening rates; diagnosis methods and rates; treatments used; patient outcomes using standardized measures
	Cross-sectional XXXX design—teacher reports on impact of intervention on student outcomes Cross-sectional responder interviews—numbers of students approaching teachers for mental health concerns; numbers of students referred by schools to community health-care centers	

With the exception of the peer mental health educator component, which was undertaken under the leadership of Dr. Hamawaka (deceased) and the Guidance, Counselling and Youth Development Centre for Africa and not conducted in Tanzania, the Tanzania sites were a replication of the Malawi intervention.

The design of these was based on formative research with young people, which assessed their current level of knowledge, awareness, and attitudes regarding mental health/mental disorders, as well their radio-listening habits and preferences. While a detailed description of the methods applied and results obtained is beyond the scope of this descriptive report and will be separately published, over 4,000 youth in both Malawi and Tanzania participated in a community survey that provided baseline data that was used to inform the design and content of the programs. Additionally, input was sought from local mental health experts and youth to create content that was accurate, appropriate, and attractive for the target audience. Called "Nkhawa Njee" in Malawi and "Positive Mood" in Tanzania, the programs aired on radio stations popular with young people. Other than a serialized, short (approx. 4–5 min per episode) soap opera, the weekly program was a freestyle show hosted live every week and, in addition to community broadcast, was linked to schools in which mental health literacy training and curriculum resources had been applied (see below) through weekly radio-listening clubs. Teachers trained in the MHL curriculum and trained peer mental health educators facilitated discussions about issues raised by the radio program.

The radio program was evaluated using a randomized cluster design that compared changes in young people's scores for knowledge, attitudes, and mental health seeking efficacy in radio "target" areas with control areas. Results show significant improvements in young people who listened to the program than in those who had no exposure to it (http://mhinnovation.net/innovations/integrated-approach-addressing-issue-youth-depression#.V5ZZ_7fdXcs).

SCHOOL-BASED APPROACHES

School-based approaches consisted of four components: 1) training teachers on the use of an MHL curriculum resource (40) that they could then use to teach students in usual classroom settings; 2) establishing school-based listening clubs (in both Malawi and Tanzania) enriched by training of peer mental health educators (Malawi only); 3) training teachers on how to identify youth showing signs and symptoms of depression; and 4) facilitating referral from schools to local community health-care providers.

The teacher training was based on the adaptation of an evidence-based Canadian school mental health literacy resource, the Guide, freely available at www.teenmentalhealth.org (34, 36–38), adapted by mental health and education experts selected by the Ministries of Health in Malawi and Tanzania to create the African Guide, which was then taught to teachers by master trainers expert in mental health and education in both countries. Thirty-five schools (a mixture of public, private, religious, boarding, and day schools) identified by the Ministries of Education and District Educational authorities were chosen as test sites in each country. Master trainers provided training to two to three teachers per school as selected by school headmasters. Research studies evaluating improvements in teacher's mental health literacy using prospective cohort designs were conducted in both countries. Teacher refresher training was conducted about 6 months following initial training. This intervention demonstrated positive impacts with significant, substantial, and sustained improvements in all aspects of teacher's mental health literacy, including improved knowledge, decreased stigma, and enhanced help-seeking personally and for friends and family members (40) as well as the application of this resource into classroom settings with positive outcomes (41–43).

Community Health-Care Provider Competence Development in Identification, Diagnosis, and Treatment of Youth With Depression

Most community-based health-care providers have received little or no training in youth mental health care in either Malawi or Tanzania. A Canadian youth Depression training program (certified by the Canadian College of Family Practice, one of the courses offered by MDcme.ca) was adapted for use in Malawi and Tanzania by mental health experts including psychiatrists, psychologists, and psychiatric nurses. All materials were translated into Chichewa (Malawi) and Kiswahili (Tanzania). Community health-care clinics were chosen by the Ministries of Health and District Health authorities for participation in the project. Master trainers in both countries were trained by the principle investigator (SK) in the use of the training program. Master trainers then trained a cadre of health-care providers from secondary-level settings who then trained health-care providers working in community health clinics in both an initial training session and a refresher course 6 months later. Prospective longitudinal cohort studies of provider knowledge, stigma, and self-confidence were conducted. Results obtained demonstrated significant positive impact of the intervention in all these domains (43–46).

In addition, patient data collection forms were created and provided to clinicians in community health centers who had received the training program. Data collected included screening for depression, numbers diagnosed, type of treatment provided, and patient outcomes. Outcomes showed both feasible and positive impacts of the intervention on care delivery and patient outcomes (44).

All clinical care providers were also trained on a psychotherapeutic intervention comprising counseling and cognitive behavioral therapy techniques developed for use by the principle investigator (SK) and a colleague expert psychotherapist (Dr. Susana Costa, Lisbon, Portugal) and designed to be used by community health-care providers to enhance non-pharmacologic treatment competencies. Trainer and provider respondent impressions of the utility and applicability of this intervention are being collected with the goal of further modification and later evaluation of the impact of this type of psychological intervention on patient outcomes in these settings.

DISCUSSION

To our knowledge, this is the first reported application of a horizontally integrated pathway to youth mental health care for depression in any low- or medium-income country. Results of all components analyzed to date show significant positive impacts in both the initial Malawi application and the Tanzania replication, suggesting that this innovative merging of mental health literacy development at both community (through radio programs) and schools (through teacher training and radio-listening clubs), case identification, and linking of schools to community clinics (supported by competency-based training in diagnosis, and treatment of youth depression at community clinics) is ready for mental health policy application in both counties and could be considered for scale out in SSA.

While this innovation may now be considered for policy-directed implementation, further study of the implementation process may also be indicated to provide a better understanding of the factors that affect policy development and innovation implementation. By comparing and contrasting the policy development and implementation of this innovation in these two different settings, it may be possible to better appreciate which aspects are generalizable and relatively easily transferred from one context to another and which may require adaptation.

We are aware that this policy-informing approach has a number of limitations. One is the ability of the Ministry of Health in any low-income country to allocate necessary resources towards youth mental health care. While funding for this work has been provided by Grand Challenges Canada, this revenue source is finite. At some point, the government will need to take on the funding challenge as well as developing the policy framework that it will sustain. Perhaps the recent announcement of the World Bank as a third-party funding source for assisting LMICs in addressing mental health-care needs will be a help with this issue (http://www.who.int/mental_health/WB_WHO_meeting_2016.pdf). As well, in both countries, the Ministries of Health have modified existing plans and resource allocations to better provide interventions and some of the resources needed to address the therapeutic needs of youth with depression.

A further set of challenges will be related to the need for Ministries of Health and Education to collaborate in the application of this innovation—at both policy and implementation levels. How to best provide MHL training to teachers in schools and how to best link schools to local community health centers will require input from both.

These cross-ministry collaborations may also need to include consideration of embedding some of the training programs into institutions that currently train health-care providers and teachers, so that the necessary care competencies can be taught in pre-service curriculum of providers and MHL to pre-service teachers. It is encouraging that to date, in both countries, the Ministries of Health (with additional funds from Grand Challenges Canada) decided to collaborate with the implementation team to field test this approach in one nursing college per country, and the results of this intervention from Malawi are currently being analyzed.

Due to difficulties in maintaining patient records at many community health centers in LMICs, it may be difficult at this time to draw firm conclusions about changes in individuals' health outcomes. We used a real world rather than a regulated test site approach to addressing this issue; thus, our results are not as pristine as those obtained from data collected in a controlled setting. On the other hand, these data are a better reflection of what is possible on the ground than is the relative serenity of a designated research setting. We anticipate difficulties with health provider compliance in updating patient tracking forms on a regular basis, as well as relatively high levels of attrition of young people receiving treatment due to lack of transportation, long wait times at clinics, and other factors that may compromise patient care as well as data collection. We do anticipate, however, that our current work will highlight barriers and provide suggestions for improving patient monitoring activities.

CONCLUSION

Taken as a whole, this evidence-based innovation applied in Malawi and replicated in Tanzania can be used to potentially inform the development of mental health policy and interventions across SSA. Such impact has already begun in both of these countries. However, we realize that there may be numerous factors at play that may prevent or limit this application. Future research will be necessary to identify both those factors that facilitate and those that impede such policy development.

DATA AVAILABILITY

Data will be provided upon request.

ETHICS STATEMENT

Ethics approval for all the Tanzania studies was received from the National Institute for Medical Research and the Ministry of Health. In Malawi, ethics approval was obtained through the Guidance, Counselling and Youth Development Centre for Africa from the Ministry of Education.

In the field interview studies of radio-listening feedback and training evaluations, verbal consent to participate was obtained from respondents, and no individual-identifying data were obtained. In the evaluation of health system studies, no individual written consent was required, as the studies used data from clinic reporting that had no individual identification.

AUTHOR CONTRIBUTIONS

SK was the principle investigator and creator of most of the educational resources used in this project. He also provided oversight of all data entry, analysis, and interpretation. KP is the director of Farm Radio International and co-investigator in the project. He also directed financial oversight and audit. HG was the project coordinator and was responsible for the on-the-ground application of all aspects of the project in both countries. MU was the lead on the Malawi component of the project. He also directed adaptation of all materials and training programs for Malawi. OU was the co-lead on the Tanzania component of the project. He also directed adaptation of all materials and training programs for Tanzania. TN was the co-lead on the Tanzania component of the project. She also directed adaptation of all materials and training programs for Tanzania. RC was the director of Farm Radio Malawi. He directed the Malawi application of the radio intervention. MH is a research assistant who was responsible for manuscript oversight, preparation, and submission.

FUNDING

Funding to support the project from which this study was generated was provided by Grand Challenges Canada (Grant Number 0090-04).

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 24 October 2019
doi: 10.3389/fpsyt.2019.00761

Exploring Differences Between Adolescents and Adults With Perinatal Depression—Data From the Expanding Care for Perinatal Women With Depression Trial in Nigeria

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Background: Depression is common among women in the perinatal period. Although pregnancy and motherhood among adolescents are global public health issues, little is known about how adolescents differ from adults in the occurrence and correlates of perinatal depression.

Methods: Data were derived from a cluster randomized controlled trial of psychosocial interventions for perinatal depression in primary maternal care in Nigeria (the Expanding Care for Perinatal Women with Depression trial). Adolescents and adult participants recruited during pregnancy and followed up till 6-month postpartum were compared: proportions with depression [screening positive to depression on the Edinburgh Postnatal Depression Scale (score ≥ 12) and meeting the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, criteria using the short form of the Composite International Diagnostic Interview]; adjustment and attitude to pregnancy and motherhood (using the Maternal Adjustment and Maternal Attitudes scale); and parenting skills (measured on Infant–Toddler version of the Home Inventory for Measurement of the Environment). Infant and fetal growth were assessed by measures of weight and head circumference at birth and upper mid-upper arm circumference (MUAC) at 6 months.

Results: Of 8,580 adults screened, 6.9% had major depression compared with 17.7% of 772 screened adolescents ($p < 0.001$). Adolescents had significantly poorer adjustment and attitudes to pregnancy, lower mean fetal gestational age at birth, and a smaller mean baby's birth weight. At 6-month postpartum, there were no significant differences in the rates of remission from depression between adolescent and adult women (Edinburgh Postnatal Depression Scale score <6). Adolescent mothers continued to have poorer maternal attitudes and parenting skills indicated by significantly lower scores on the Infant–Toddler version of the Home Inventory for Measurement of the Environment responsivity and involvement subscales. Infants of adolescent mothers had a higher rate of undernutrition (defined as MUAC < 12.5 cm) compared with those of adult mothers:

OPEN ACCESS

Edited by:
Manasi Kumar,
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Reviewed by:
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University of Nigeria,
Nigeria
Simone Honikman,
University of Cape Town,
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Specialty section:
This article was submitted to
Public Mental Health,
a section of the journal
Frontiers in Psychiatry

Received: 15 April 2019
Accepted: 23 September 2019
Published: 24 October 2019

Citation:
Oladeji BD, Bello T, Kola L, Araya R, Zelkowitz P and Gureje O (2019) Exploring Differences Between Adolescents and Adults With Perinatal Depression—Data From the Expanding Care for Perinatal Women With Depression Trial in Nigeria. Front. Psychiatry 10:761. doi: 10.3389/fpsyt.2019.00761

14.8 and 6.3%, respectively (p = 0.008), with the mean MUAC remaining significantly lower for infants of adolescent mothers after adjusting for their lower birth weight (p = 0.04).

Conclusion: Perinatal depression is more common and is associated with poorer maternal attitudes and parenting skills in adolescents compared with those in adults. Evidence from this exploratory study suggests that in improving outcomes in infants of adolescent mothers with perinatal depression, depression treatment may need to be supplemented with specific approaches to improve parenting skills.

Keywords: adolescents, women, perinatal depression, primary health care, low- and middle-income countries

INTRODUCTION

The World Health Organization (WHO) estimates that despite the declining global rates of adolescent pregnancy, up to 11% of all births worldwide are still to girls aged between 15 and 19 years (1). The global rate for adolescent pregnancy in the 2015 World Health Statistics is about 44 per 1,000 girls between the ages of 15–19 years with a range of 1–201 across countries. The highest rates are in countries in sub-Saharan Africa; Nigeria, for example, has a birth rate of 109 per 1,000 adolescents in 2015 down from a peak of 172/1,000 in 1977 (2). Adolescent pregnancy often presents a unique set of challenges and risk factors compared with pregnancy in adulthood. In addition to contending with normal demands of navigating the developmental tasks of adolescence, pregnant adolescents have to adapt to the responsibilities and demands associated with becoming a parent. Adolescent pregnancy is associated with adverse birth outcomes including elevated risks of obstetrical complications, lower birth weight babies, and maternal mortality (3–5). In addition, adolescent mothers who face poor social and economic conditions and prospects are more likely to experience parenting difficulties and further pregnancies in adolescence (6, 7).

An important associated morbidity of adolescent pregnancy is mental illness (8). Compared with adult women, pregnant adolescents are at a significantly increased risk for common mental disorders (9). For example, the risk for perinatal depression, a condition that has received the most attention in the literature, is double in adolescents relative to older women (10, 11). The prevalence rates for perinatal depression in adolescents are estimated to be between 16 and 44% compared with 5–20% in adult women (7, 9, 12). The risk factors for perinatal depression in adolescents are largely similar to those in adults and include low socioeconomic status and low perceived social support (9, 10).

Similar to findings in adult women, perinatal depression in adolescent mothers is associated with negative birth and infant outcomes. Perinatal depression in adolescent mothers increases the risk for small-for-gestational-age babies and preterm delivery (13). In addition and more specifically, adolescent mothers with depression have poor interactions with their babies and are more likely to use aggressive parenting behaviors with their children (14). Children of adolescent mothers are more likely to develop preschool problem behaviors, have delays in cognitive development, have higher levels of psychopathology, poorer school performance, and are at higher risk of also becoming teenage parents (9, 15).

Till date, there is limited empirical information about effective interventions for prevention and treatment of perinatal depression in adolescents. In a systematic review of the literature conducted in 2014, Lieberman and colleagues were able to identify only two treatment studies (16). One study evaluated the effectiveness of group interpersonal therapy among 11 pregnant girls (mean age 16.5 years) with Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) major depression over a 12-week period (17). The other study assessed the impact of a telephone-based depression collaborative care program consisting of motivational interviewing and psychoeducation over 6 months among 97 teenage mothers (mean age 16.4 years) (18). Both studies reported positive outcomes in the adolescents following treatment. Neither of the studies examined impact of treatment on the infants and neither had a control group nor used a randomized controlled design.

Most of the previous studies on risks, consequences, and treatment of perinatal depression in adolescents have come from high-income countries with little available information from low- and middle-income countries where, as previously shown, there is indeed a much higher rate of adolescent pregnancy. More generally, the paucity of rigorously conducted studies on treatment of adolescents with perinatal depression may reflect the difficulties of engaging with and conducting research on this vulnerable group where ethical issues relating to research participation are likely to constitute added disincentive for researchers. Specifically, an important gap in the global literature is information about whether there are unique and peculiar features that set adolescents with perinatal depression apart from adults with the same condition or that may affect their response to treatment. Identifying such unique features will be a first and vital step in designing age-appropriate interventions for this vulnerable group of mothers.

In this exploratory study, we used data from a randomized controlled study conducted in primary maternal care clinics in Nigeria to compare adult and adolescent participants with regard to the occurrence as well as maternal and infant correlates of perinatal depression both during pregnancy and 6-month postpartum.

MATERIALS AND METHODS

The data for this report are from the Expanding Care for Perinatal Women with Depression (EXPONATE) trial. This two-arm parallel cluster randomized control trial of psychosocial interventions for perinatal depression in primary health care was conducted in Ibadan, Southwest Nigeria between June 18, 2013 and December 11, 2015. A full description of the study protocol as well as the results of the trial has been published (19, 20), and only a summary of the methodology relevant to the current study will be described here. The unit of randomization was primary maternal care clinics in the study area, while the unit of analysis was individual women participants. Twenty-nine eligible and consenting primary maternal and childcare centers were randomized into either the stepped-care structured psychosocial intervention (high-intensity) arm (15 clinics) and enhanced usual-care (comparison or low-intensity) arm (14 clinics). Eligible clinics were those with a capacity to offer antenatal, delivery, and postnatal services.

Consecutive pregnant women registering for antenatal care at the participating clinics were approached for screening and assessed for eligibility while waiting to be seen by the primary health care worker (PHCW). Screening was conducted by trained research staff using the Edinburgh Postnatal Depression Scale (EPDS). Eligible participants were those with an EPDS score of 12 or more, aged between 16 and 45 years, had fetal gestational age between 16 and 28 weeks, were likely to remain in the area of the study for the duration of follow-up, and provided written informed consent. Women who did not meet diagnostic criteria for DSM-IV major depression, following assessment with the short form of the Composite International Diagnostic Interview, or had a history of bipolar affective disorder or psychotic disorder and those who were actively suicidal were excluded. Participants who consented to the study were offered either a low- or high-intensity psychosocial treatment delivered by primary maternal care providers in either of the two arms of the study. Participants in the high-intensity intervention arm had the EPDS readministered to them by the PHCW during their routine postnatal visits 6 weeks after childbirth to determine the number of additional postnatal intervention sessions.

Standard care in the randomized clinics were delivered by PHCW who had, prior to the trial, received training on the identification and treatment of depression based on the specifications of the WHO Mental Health Gap Action Intervention Guide (mhGAP-IG). In addition to the mhGAP-IG training, providers in the high-intensity treatment arm were trained to deliver a manualized structured stepped-care psychosocial intervention package (20). The package included psychoeducation, activity scheduling (behavioral activation), and a locally adapted form of problem solving treatment delivered in eight prenatal sessions with additional four to eight supplementary postnatal sessions determined by level of remission of patient's depression symptoms as determined by their EPDS score (21).

Participants in the low-intensity treatment arm were provided with care as usual, that is, unstructured psychosocial interventions based on treatment specification for perinatal depression in the mhGAP-IG consisting of psychoeducation, addressing current psychosocial stressors, and reactivation of social network with no prespecified number of sessions.

The EXPONATE trial from which the data for this study were derived was approved by the University of Ibadan/University College Hospital Ibadan Ethical Review Committee.

Measures

The primary outcome for the trial was depression remission at 6-month postpartum, defined as EPDS score of less than six. The EPDS is one of the most widely used screening instruments for assessing symptoms of perinatal depression. The EPDS has been used and validated in the several low- and middle-income countries including Nigeria (22).

At baseline, following enrollment, participants were assessed for disability, measured with the WHO Disability Assessment Schedule (23), experience of stigma using the 12-item Discrimination and Stigma Scale (24), and for adjustment and attitudes to pregnancy, with the Maternal Adjustment and Maternal Attitudes (MAMA) questionnaire. These tools, including the postnatal version of MAMA, were readministered at 6-month postnatal, which was the primary outcome point for the trial. Also, at 6-month postnatal, the Infant and Toddler version of the Home Inventory for Measurement of the Environment (IT-HOME) was used to assess the extent to which the infant was receiving adequate home and parental nurturing.

The MAMA is a 60-item questionnaire designed to assess maternal adjustment and attitudes during pregnancy and after delivery. It has demonstrated good acceptability to women and good reliability in the United Kingdom (25) and Portugal (26). For this study, we used the 12 items on the attitude to pregnancy and baby subscale of the MAMA, which includes questions such as "have you been worrying you might not be a good mother?" and "have you been looking forward to caring for your baby's needs?" Each item is scored on a four-point Likert scale (with negatively worded items reverse scored). In our scoring and analysis, higher scores denoted poorer maternal attitudes. The scale showed good inter-rater reliability (alpha coefficient of 0.7).

The HOME is designed to provide systematic measurement of the family environment. The HOME inventory has different versions designed to explore the home environment at different stages of child development; for this study, we used the IT-HOME. Some items on the HOME are scored based on information provided by the parents and others by direct observation by the interviewer (27). The full scale consists of 45 items, which are scored either yes (1) or no (0) according to the manualized description of each item as adapted for the local context. The scale is divided into six subscales—1) responsivity (a measure of the extent to which the parent responds to the child's behavior); 2) organization, 3) involvement, and 4) acceptance (assess parental acceptance of less-than-optimal behavior from the child and the avoidance of undue restriction and punishment); and 5) learning materials, and 6) variety.

We followed standard procedures for the cultural adaptation of psychological instruments used in this study (MAMA, HOME, and EPDS) (28, 29). This process consisted of translation and back translation of the items in the tools by a panel of bilingual experts, followed by a review of the items for cultural relevance by a panel of experts (which included persons with professional experience in childcare—a sociologist, social worker, primary care providers, as well as mothers with infants). The study research staff conducting the outcome assessments were then trained, following which reliability exercises were conducted for each tool. For the HOME, in view of the salience of interviewer observation in addition to respondents' reports, each of the research workers conducted two video recorded assessments that were used for further training and to standardize the administration and scoring of each of the item on the HOME record form. After this standardization process, each conducted two further assessments that were similarly video recorded, and the recordings were used to assess interrater reliability. The instrument showed good interrater reliability (alpha coefficient was 0.94 for the full-scale measure on the IT-HOME).

Other outcome measures assessed include birth outcomes (mode of delivery, live births, gestational age at birth, and birth weight), infant growth [mid-upper arm circumference (MUAC) at 6 months], and infant nutrition (practice of exclusive breast feeding for the first 6 months of life). Infant under nutrition was defined according to WHO standards as MUAC < 12.5 cm (30, 31).

Assessments were conducted at baseline, 2 months after baseline, at birth, and 3- and 6-month postpartum in the participants homes by six trained research assistants who were not involved with collecting data in the clinics and were blinded to the arm of the study that the participants were recruited into.

Statistical Analysis

Data that were saved and uploaded to a secure server and exported into the statistical software were collected using android tablet computers. The data were cleaned and analyzed using STATA (STATA/SE 13.1) software. Student t-tests and ANOVA were used to assess the differences in mean scores between perinatal adolescents and adults on continuous variables such as gestational age, EPDS scores, education, stigma, and disability scores. While categorical variables were compared using the chi-square test. We adjusted the effect of the lower birth weight of adolescent mothers on MUAC at 6 months by entering both variables simultaneously in linear regression models.

RESULTS

A total of 9,352 pregnant women were screened with the EPDS; 772 (8.3%) of these were adolescents, aged 19 years and under. Adolescents constituted 20% of the 686 women recruited into the trial (**Figure 1**). We successfully conducted 6-month postdelivery assessments on 579 (84.5%) of the participants; these included 109 adolescents (83.2% of the enrolled adolescents).

The mean age of the adolescents was 17.8 (SD 1.23) years compared with 26.3 (SD 5.07) years for the adults ($p < 0.001$); 86.8% of the adults were either married or cohabiting with a partner, while for the adolescents, 53.4% reported being married or cohabiting ($p < 0.001$). The gestational age of mothers at enrollment was similar for adolescents and adult women, at mean 21.3 (SD 3.6) weeks and 22.0 (SD 3.7) weeks, respectively.

Of the 8,580 adult women screened, 590 (6.9%) scored 12 or more on the EPDS and met the DSM-IV criteria for depression. On the other hand, of the 772 screened adolescents, 137 (17.7%) had depression (chi-square = 116.721, $p < 0.001$). Depression severity at baseline as determined by the mean EPDS score for adolescents (14.9, SD 2.6) was not significantly different from that of the adult population (14.4, SD 2.7) ($p = 0.08$). At baseline, the adolescents had poorer adjustment and attitudes to pregnancy than adults as indicated by significantly higher scores on the MAMA questionnaire, but the two groups were not significantly different on other parameters (**Table 1**).

Even though mode of delivery was similar between the two groups (normal delivery in 98.3% adolescents and 96.8% adults), adolescent mothers delivered at an earlier gestational age and had significantly smaller babies at birth (mean weight: 2.9 versus 3.0 kg, $p = 0.002$) (**Table 2**).

In the intervention arm, fewer adolescents completed the required eight sessions prenatally compared with adult women (53.8% compared with 63.2%), but this difference was not statistically significant ($p = 0.120$).

At 6 months after childbirth, depression remission (EPDS < 6) was similar across both arms: 66% in the control arm and 70% in the intervention arm (odds ratio: 1.3; 95% confidence interval: 0.8, 2.0; $p = 0.34$) (20). In this regard, adolescent mothers with depression were as likely to have experienced remission as the adult women, 70.6 and 68.7%, respectively (odds ratio: 1.09; 95% confidence interval: 0.69, 1.73).

On the other hand, and compared with adult mothers, adolescent mothers continued to have poorer attitudes and adjustment to motherhood at 6-month postnatal follow-up. Parenting skills were also poorer in the adolescent mothers as evidenced by their significantly lower overall scores on the IT-HOME, as well as on the subscale scores of responsivity and involvement (**Table 3**).

With regard to infant nutrition, even though fewer (11.9%) adolescent mothers compared with adult mothers (16.6%) reported feeding their babies exclusively on breast milk for the first 6 months of life, the difference was not significant ($p = 0.23$). However, adolescent mothers had a higher rate of undernourished infants (defined as MUAC < 12.5 cm) compared with adult mothers, 14.8 and 6.3%, respectively

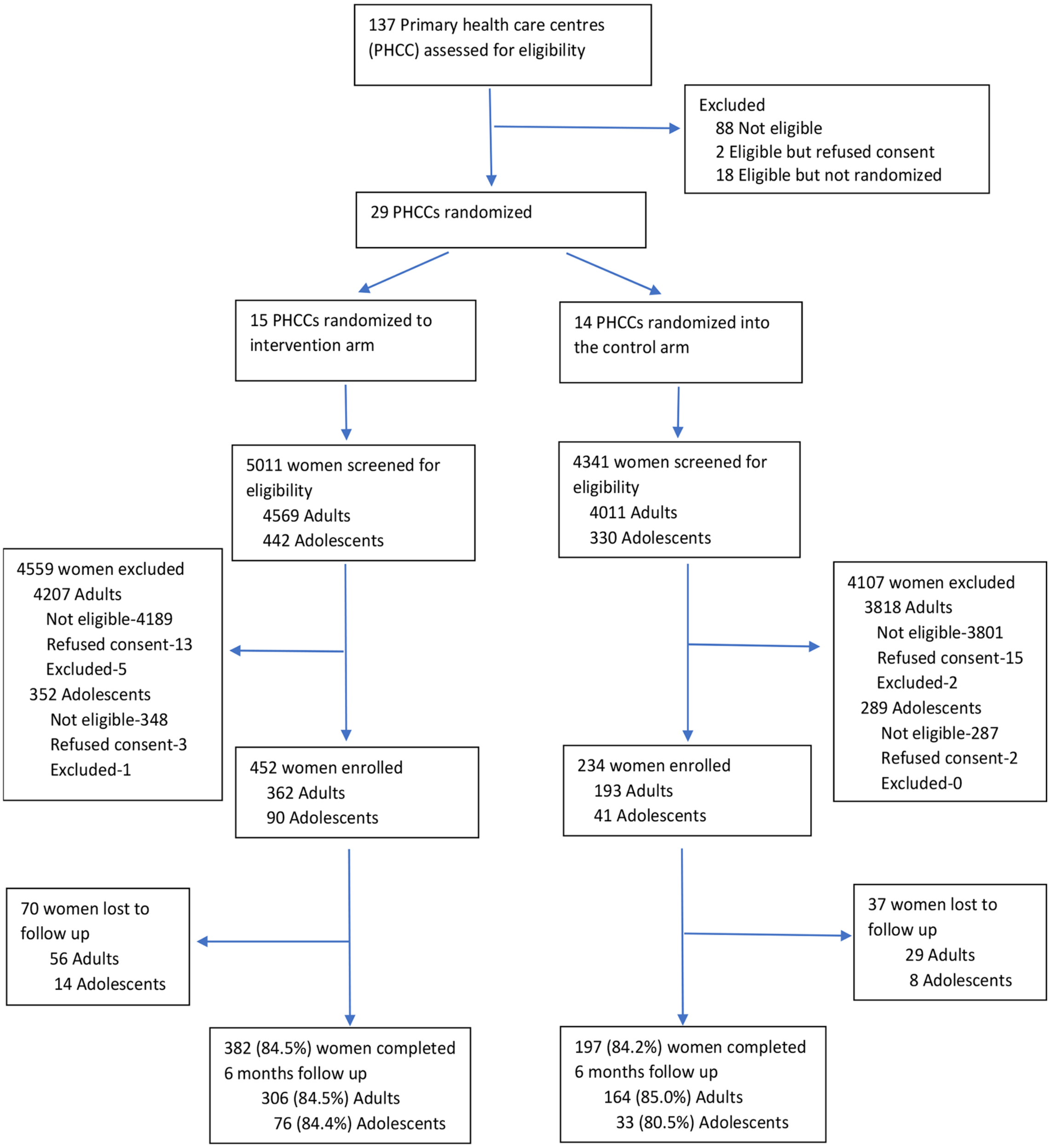

FIGURE 1 | Flow diagram for adolescent and adult mothers.

(p = 0.008). The mean MUAC was significantly lower in the infants of adolescent mothers (p = 0.008), and this difference persisted even after we adjusted for their lower weight at birth (p = 0.04).

DISCUSSION

This study provides information regarding the rates of perinatal depression, its correlates, as well as postpartum differences between adolescents and adults who were enrolled into a randomized controlled trial of two forms of intervention for perinatal depression in a lower middle-income country. Results are presented comparing attitudes to motherhood, parenting skills, as well as growth and development of infants born to both groups of mothers. This study is unique in that we were able to compare the prevalence and outcomes of perinatal depression in a sample drawn from the same population who had undergone similar treatment exposures. While the severity of perinatal depression did not appear to differ between the adolescents and

TABLE 1 | Baseline demographic and clinical variables.

Continuous	**High-Intensity Treatment Arm**			**Low-Intensity Treatment Arm**			**Total**		
	Adolescent mean (SD)	**Adult mean (SD)**	**p-value**	**Adolescent mean (SD)**	**Adult mean (SD)**	**p-value**	**Adolescent mean (SD)**	**Adult mean (SD)**	**p-value**
Age	17.92 (1.26)	26.19 (5.01)	<0.001	17.63 (1.16)	26.48 (5.18)	< 0.001	17.83 (1.23)	26.29 (5.07)	<0.001
Education	10.20 (2.10)	10.71 (3.14)	0.188	9.94 (2.38)	10.56 (3.37)	0.301	10.12 (2.19	10.66 (3.22)	0.096
Gestational age (weeks)	21.3 (3.6)	22.0 (3.7)	0.129	22.2 (4.3)	22.6 (4.0)	0.503	21.6 (3.8)	22.2 (3.8)	0.102
EPDS	14.70 (2.59)	14.25 (2.71)	0.152	15.27 (2.50)	14.77 (2.58)	0.261	14.88 (2.57)	14.43 (2.67)	0.082
WHODAS	18.62 (5.41)	18.06 (4.76)	0.328	19.17 (6.29)	19.53 (6.37)	0.744	18.79 (5.68)	18.57 (5.41)	0.673
DISC	15.97 (4.28)	16.69 (4.83)	0.196	16.29 (4.55)	17.55 (5.25)	0.154	16.07 (4.35)	16.99 (4.99)	0.052
MAMAS	21.42 (5.30)	19.52 (4.68)	0.001	22.76 (5.85)	20.20 (4.77)	0.003	21.84 (5.49)	19.76 (4.72)	<0.001

EPDS, Edinburgh Postnatal Depression Scale; WHODAS, WHO Disability Assessment Schedule; DISC, 12-item Discrimination and Stigma Scale; MAMAS, Maternal Adjustment and Maternal Attitudes Questionnaire (higher scores indicate poorer attitudes); Low-Intensity Treatment Arm, Interventions consist of basic psychosocial interventions specified in the WHO Mental Health Treatment Gap Action Programme Intervention Guide (mhGAP-IG); High-Intensity Treatment Arm, Interventions consisting of the mhGAP-IG interventions, activity scheduling and problem solving treatment.

TABLE 2 | Birth outcomes

	Adolescents	**Adults**	**P value**
Mode of delivery			
Normal delivery, n (%)	114 (98.3)	489 (96.8)	0.403
Others (Caesarean section or instrumental delivery), n (%)	2 (1.7)	16 (3.2)	
Gestational age at birth, mean (SD)	35.8 (4.1)	37.0 (3.4)	0.001
Birth weight in kilograms, mean (SD)	2.9 (0.4)	3.0 (0.4)	0.002
Head circumference in centimeters, mean (SD)	32.8 (6.5)	33.4 (5.4)	0.318

adults, the rate of depression was almost thrice that in adults. Overall, in the trial from which the current findings are drawn, treatment outcomes were similar in both the intervention and the control arms, with remission rates of 70 and 66%, respectively. We found the remission rates to be similar in the subsamples of adults and adolescents in the trial. However, the study was not powered for a comparison of subgroup treatment outcomes between the adolescent and adult mothers. The main differences between the adolescents and adults with perinatal depression in this study were in their attitudes and adjustments to pregnancy and motherhood, their parenting skills, and infant outcomes. In each of these, adolescent mothers had significantly lower scores than adult mothers and their infants.

TABLE 3 | Six month outcome.

	High-Intensity Treatment Arm			**Low-Intensity Treatment Arm**			**Total**		
	Adolescents	**Adults**		**Adolescents**	**Adults**		**Adolescents**	**Adults**	
6months Secondary outcomes	**mean (SD)**	**mean (SD)**	**p-value**	**mean (SD)**	**mean (SD)**	**p-value**	**mean (SD)**	**mean (SD)**	**p-value**
WHODAS	13.74 (3.36)	13.68 (2.99)	0.891	13.94 (3.77)	14.43 (3.60)	0.480	13.80 (3.47)	13.94 (3.23)	0.679
DISC	13.76 (3.54)	14.24 (3.92)	0.333	14.48 (5.50)	14.87 (4.38)	0.663	13.98 (4.21)	14.46 (4.09)	0.275
MAMAS	21.10 (5.23)	19.55 (3.86)	**0.005**	22.40 (6.43)	20.25 (4.75)	**0.035**	21.48 (5.60)	19.79 (4.19)	**0.001**
IT-HOME									
Responsivity	8.04 (1.78)	8.57 (1.79)	**0.025**	7.87 (2.46)	8.56 (1.72)	0.065	7.99 (1.99)	8.57 (1.76)	**0.004**
Organization	4.66 (1.20)	4.95 (0.98)	**0.032**	4.86 (1.13)	4.83 (1.11)	0.884	4.72 (1.18)	4.91 (1.03)	0.101
Involvement	2.89 (0.92)	3.15 (0.95)	**0.037**	3.07 (1.14)	3.24 (1.03)	0.417	2.94 (0.99)	3.18 (0.98)	0.027
Acceptance	6.01 (1.27)	5.94 (1.20)	0.632	5.80 (1.37)	5.85 (1.22)	0.848	5.95 (1.30)	5.91 (1.20)	0.738
Total score	25.90 (4.37)	27.33 (4.56)	**0.018**	25.72 (5.92)	27.05 (4.51)	0.172	25.85 (4.84)	27.23 (4.54)	0.007
Infant MUAC [cm]	14.3 (1.5)	14.7 (1.6)	0.126	13.9 (1.7)	14.8 (1.7)	**0.017**	14.2 (1.5)	14.7 (1.6)	**0.008**

WHODAS, WHO Disability Assessment Schedule.
DISC, 12-item Discrimination and Stigma Scale.
MAMAS, Maternal Adjustment and Maternal Attitudes Questionnaire (higher scores indicate poorer attitudes).
IT-HOME, Infant Toddler version of the Home Inventory for Measurement of the Environment.
Low-Intensity Treatment Arm, Interventions consist of basic psychosocial interventions specified in the WHO.
Mental Health Treatment Gap Action Programme Intervention Guide (mhGAP-IG).
High-Intensity Treatment Arm, Interventions consisting of the mhGAP-IG interventions, activity scheduling and problem solving treatment.
MUAC, Mid-Upper Arm Circumference.
Level of significance set at $p < 0.05$.

There are wide variations in the reported prevalence of perinatal depression in adolescent populations ranging between 8 and 47%, probably reflecting methodological factors, especially differences in the ascertainment procedures and in the criterion definition of depression (9). Nevertheless, in this study and similar to reports in other populations of perinatal women from other parts of the world, the prevalence of depression in adolescents was much higher compared with that in adults (10–12).

We believe that our findings are an important contribution to the growing body of evidence that younger maternal age is a strong predictor of adverse pregnancy outcomes (32, 33). Compared with adult mothers, the adolescents delivered at an earlier gestational age and their infants had significantly lower birth weights than infants born to adult mothers. Relatedly, despite similar feeding patterns, the babies of adolescent mothers were less nourished at 6 months of life. Premature delivery and low birth weight infants are two important surrogate markers for adverse pregnancy outcome and infant mortality (33, 34). While studies have consistently found associations between infant birth weight and maternal age, the findings relating to the underlying risk factors for this association have not been consistent (4, 32). Associated factors for the shorter gestational age at delivery and lower birth weight of babies of adolescent mothers identified in the literature include social disadvantage, reduced antenatal visits, ethnicity, age at menarche, maternal height and net weight gain, and health behaviors during pregnancy as well as biological immaturity (33, 35, 36). Both the adult women and the adolescents in our study were recruited from essentially the same socioeconomic backgrounds and received similar antenatal care, suggesting that these two factors were not likely to explain the observed differences in this study. However, the poorer maternal attitudes observed in the adolescents during pregnancy could have resulted in reduced likelihood of adopting healthy eating and self-care habits that could have, in turn, impacted on fetal outcomes.

The results of this study suggest that while psychosocial interventions for depression seem to have been effective in reducing symptoms of depression among adolescent mothers, this remission of depression symptoms did not translate to improvement in parenting skills and adjustment to motherhood. The adolescents were less involved with and responsive to their infants as measured on the respective scales on the HOME inventory at 6 months, and the scores on the MAMA scales remained indicative of difficulties adjusting to parenting.

In this study, even though similar infant feeding patterns were reported by the adult and adolescent mothers, a significantly higher proportion of the infants of the adolescent mothers were undernourished as indicated by MUAC of less than 12.5 cm. The difference in the mean MUAC between adult and adolescent mothers persisted even after we controlled for the smaller birth weight of the infants of adolescent mothers. MUAC is a commonly used proxy for infant nutritional status and has been indicated as a more sensitive prognostic indicator for mortality than weight-for-height parameters in malnourished pediatric patients (37). Even though we did not collect data to enable us to determine the specific causes of the poorer infant nutrition in adolescent mothers, there is a possibility that this might be related to their poorer parenting skills, which could have affected infant feeding and the introduction of weaning diet.

The observations relating to worse perinatal outcomes in adolescent pregnancy are a relatively consistent finding from many parts of the world and have significant public health implications (4, 33). As noted in a recent report, there is a need for targeted interventions for this group of mothers especially in regions such as sub-Sahara Africa where high rates of adolescent pregnancy are still common. Interventions would need to target the prevention of child marriage and of unplanned pregnancies, provision of universal access to sexual and reproductive education (including contraception), and encouraging girls to receive secondary level education, which may serve to delay age at the birth of the first child (38). The findings of the current study suggest that for adolescents, approaches aimed at improving parenting skills would be a necessary component in developing care models and intervention packages for perinatal depression.

One major strength of this study is the selection of adult and adolescent mothers from the same population with similar treatment experience and socioeconomic backgrounds and, hence, reducing variations related to the quality of care. Our follow-up rates were high, and the study used standardized ascertainment procedures. Nevertheless, the study does have some limitations that should be considered in interpreting the findings. The first and more important is that the study was not powered to assess the effectiveness of treatment among adolescents with perinatal depression nor for subgroup comparison of outcome between adolescents and adults. Even so, previous studies exploring outcome of treatments among adolescents with perinatal depression have had fewer participants and employed less robust methodological approaches (16). Second, there are a number of unmeasured confounding factors that could have accounted for the higher rates of malnourished infants in the adolescent mothers, such as differences in weaning practices between adolescent and adult mothers. Another important limitation pertains to the assessment tools for the outcome measures (especially the HOME and MAMA); while these tools have been extensively used and validated in adult populations in other cultures, data regarding their psychometric properties and cultural acceptability in adolescent populations as well as in adults in low- and middle-income settings are not readily available. Notwithstanding these limitations, the findings of this study provide strongly suggestive evidence for a need to take into account the peculiar and unique characteristics of adolescent mothers with perinatal depression in designing an appropriate and effective intervention for the condition. This is particularly so given the salience of good parenting skills to adequate infant growth and development.

DATA AVAILABILITY STATEMENT

The datasets are available on request to the most senior author and PI of the study. E-mail: ogureje@com.ui.edu.ng

ETHICS STATEMENT

The EXPONATE study was carried out in accordance with the recommendations of the University of Ibadan/University College Hospital Ibadan Ethical Review Committee. Each individual participant provided written informed consent.

AUTHOR CONTRIBUTIONS

OG conceived the study and, along with BO, RA, PZ, and LK, obtained funding. BO produced the first draft of the manuscript and with input from OG, PZ, and RA. TB conducted the statistical analysis. All authors approved the final version.

FUNDING

The EXPONATE study was funded by Grand Challenges Canada (0082–04).

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer SH declared a shared affiliation, with no collaboration, with one of the authors BO to the handling editor.

frontiers
in Psychiatry

REVIEW
published: 29 October 2019
doi: 10.3389/fpsyt.2019.00795

Maternal Nutrition and Offspring Stress Response—Implications for Future Development of Non-Communicable Disease: A Perspective From India

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Psychological stress is recognized as a major modifiable risk factor for adult non-communicable disease (NCD) that includes depression, type 2 diabetes mellitus, and cardiovascular disease. Dysregulation of hypothalamic-pituitary-adrenal (HPA) axis activity resulting in either exaggerated or blunted cortisol responses, and altered autonomic cardiovascular control have been thought to underlie this association. The developmental origins hypothesis proposes that impaired nutrition during fetal and early postnatal growth is associated with a higher NCD risk later in life. Maternal nutrients are vital for fetal growth and development, and both maternal undernutrition and over nutrition as in the case of gestational diabetes are associated with higher NCD risk markers in the offspring. Recent studies suggest that fetal exposure to maternal nutritional imbalances may permanently alter cortisol and cardio-sympathetic stress-responsiveness, which may link early life nutrition with adult disease risk. A few recent studies that examined the association between low birth weight as a marker of fetal undernutrition and stress response in humans showed that lower birth weight was associated with an altered HPA axis and cardiovascular sympathetic nervous system responses to stress in adults as well as in children. In addition, altered stress responses in relation to gestational diabetes have been noted. In this paper, we present available evidence from India for the association between maternal nutrition and offspring stress responsiveness against the backdrop of global evidence, and discuss its role in the escalating NCD rates in this population. We also discuss the scope for future studies in India and other transitioning countries.

Keywords: stress response, nutrition, non-communicable disease, cortisol, gestational diabetes

OPEN ACCESS

Edited by:
Manasi Kumar,
University of Nairobi, Kenya

Reviewed by:
Anja C. Huizink,
Vrije Universiteit Amsterdam,
Netherlands
Anne Louise Jaquiery,
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Specialty section:
This article was submitted to
Child and Adolescent Psychiatry,
a section of the journal
Frontiers in Psychiatry

Received: *02 April 2019*
Accepted: *04 October 2019*
Published: *29 October 2019*

Citation:
Krishnaveni GV and Srinivasan K
(2019) Maternal Nutrition and
Offspring Stress Response—
Implications for Future Development
of Non-Communicable Disease: A
Perspective From India.
Front. Psychiatry 10:795.
doi: 10.3389/fpsyt.2019.00795

INTRODUCTION

There has been a steady increase in type 2 diabetes, cardiovascular disease, and other non-communicable diseases (NCD) including depression in the world, but this increase is pronounced in transitioning countries such as India (1). This may be a direct consequence of changing lifestyle behaviors and environmental factors giving rise to increased vulnerability to adiposity and other intermediary phenotypes for NCDs in these populations. Psychological stress is recognized as one such lifestyle-related risk factor (2). Stress is a negative subjective experience that occurs when an individual perceives that the situational demands exceed his/her adaptive capacity (3). Body responds to stress by the activation of the hypothalamic-pituitary-adrenal (HPA) axis (and its end product cortisol) and the autonomic nervous system (ANS), which in turn lead to various physiological changes that help to maintain homeostasis (2). On repeated exposure to stress, a dysregulated HPA axis activity and autonomic cardiovascular control, reflected in either exaggerated or blunted responses of these systems to acute stress has been thought to result in cardio-metabolic, neuro-endocrine, and immunological aberrations responsible for NCDs. Studies in humans show that individuals who show abnormal stress responses are at an increased risk for developing cardiovascular and mental health disorders (4, 5).

It is suggested that a number of biological, environmental, and social factors during different stages of life course may confer variations in stress reactivity among different individuals, and thus susceptibility to future development of diseases (6). Fetal HPA axis is responsive and influenced by external stimuli (7). There is evidence from both human and animal studies that several life style related factors during pregnancy that includes maternal diet, sleep pattern, and physical activity may impact fetal programming through alterations in fetal HPA axis activity (8–10). Among the life style factors, maternal under nutrition during the prenatal period is an important programming signal that has enduring effects on the off spring (11). The current review examines the available evidence linking impaired maternal intra-uterine nutrition with offspring stress responses, with particular emphasis to studies in India which is experiencing an escalating prevalence of NCDs.

The Developmental Origins of Health and Disease

The Developmental Origins of Health and Disease (DOHaD) hypothesis proposes that impaired nutrition during critical stages of fetal development results in permanent changes in structure and function of key physiological systems (programming) (12). The resulting phenotype offers the maximum survival chances at the available nutrition, by preserving brain growth at the cost of other visceral systems (thrifty phenotype). However, it is proposed that the same phenotype predisposes the individual to insulin resistance, type 2 diabetes, and other NCDs when exposed to "surplus" nutrition in later life. This programming hypothesis often referred to as the Barker hypothesis states that a mismatch between intrauterine and extra-uterine environment results in birth of child that is inadequately adapted for function in the extra-uterine environment and consequently is at risk for later development of chronic medical conditions such as NCDs (13).

The fetal programming hypothesis was initially described by David Barker and colleagues, who showed among UK adults that the prevalence of type 2 diabetes and coronary heart disease was higher in individuals with lower birth weights (14, 15). Similar findings of an association between lower birth weight and a higher risk of coronary heart disease was observed in a study from Mysore, South India (16). Subsequently, these findings were replicated in many different populations.

Particularly, studies from Helsinki Birth Cohort, Finland showed associations of lower size at birth (weight and ponderal index) and at 1 year (weight, height, and body mass index) with a higher prevalence of coronary heart disease (17). A recent study from Helsinki also showed that individuals born small-for-gestational age had significantly higher risk of severe mental disorders during adulthood (18). In another study by *Raikkonen et al.*, adult men who had lower birth size (weight, length, and head circumference) and slower postnatal growth during the first 2 years of life had poorer cognitive abilities in late adulthood (19).

The Dutch Hunger Winter Families studies showed that the individuals exposed to famine conditions *in utero* were more likely to be obese and had a higher prevalence of cardio-metabolic disease and depression (20). Thus, the DOHaD hypothesis now encompasses both maternal undernutrition and overnutrition (for e.g., gestational diabetes mellitus/GDM) as playing a critical role in fetal programming.

Early Origins of Stress Responses

There is a growing body of evidence from studies in the West that early life factors, including nutrition, may permanently alter stress-responsiveness in humans. This may be an important mechanism in the development of adult chronic diseases. As exemplified by the stress-diathesis model, individuals exposed to similar environmental circumstances react quite differently and central to this paradigm is individual "vulnerability characteristics" that determines a heightened sensitivity to environmental stressors (21). In addition, this heightened sensitivity to environmental stressors operates across life cycle and although rooted in neurobiology and genetic susceptibility, is influenced by developmental processes and life experiences and thus, the consequences for the individual are sustained. From a DOHaD perspective, the individual "vulnerability characteristics" are shaped by both genetics and intrauterine programming.

One of the most studied prenatal factors contributing to altered stress reactivity in children is that of prenatal stress. Prenatal stress refers to an array of affective states that includes distinct but overlapping constructs of anxiety, depression, pregnancy specific anxiety, and response to major life stressors. The effect of maternal depression on altered stress reactivity in children is the best studied. (22). While several studies have shown that exposure to prenatal depression is associated with higher cortisol reactivity (23), blunted HPA axis response and higher systolic blood pressure reactivity (24, 25), others did not report any association between prenatal depression and cortisol reactivity in children (26). A recent review on the association between prenatal depression and altered HPA axis and ANS response in offspring concluded that the evidence is weak (27), but suggested that longitudinal studies of children exposed to prenatal depression may be needed for greater clarity. Anxiety is often co-morbid with depression and maternal cortisol levels are higher in women who have both anxiety and depression compared to women with either anxiety or depression (28).

Furthermore, maternal anxiety co-morbid with depression during pregnancy had an additive effect on children's stress reactivity (29). Others too have noted that prenatal anxiety as opposed to prenatal depression is associated with later adverse child outcomes (30). Recent decades has seen an increasing interest in studying the impact of prenatal stress specific to pregnancy such as anxieties related to labor and delivery on child health outcomes (31, 32). Pregnancy specific anxiety is reported to be associated with altered epigenetic pattern in glucocorticoid receptor in the newborn (33). It is not yet clear whether each of these psychological constructs, which can often co-exist together, confer differential biological risk and thus, results in distinct child health outcomes (34).

Maternal Nutrition and Stress Responses

Maternal nutrients are vital for the development of the fetus *in utero*. Maternal malnutrition has been shown to be associated with changes in placental morphology and blood flow resulting in inadequate supply of nutrients to the fetus (35). It has been proposed that impaired fetal nutrition alters neuro-endocrine structure and function, and impacts HPA axis feedback systems through glucocorticoid receptors (36, 37), and influences stress reactivity. Specific nutrients in the mother, including B vitamins and choline play a critical role in regulating the expression and functioning of factors related to offspring stress system through epigenetic changes (38, 39). Studies in humans and animals have shown that methylation levels in the promoter regions of the gluco-corticoid receptor and 11β-HSD2 genes may be influenced by maternal undernutrition and/or GDM and have adverse implications for offspring stress responses (40–42). In the following sections we will examine the evidence linking altered maternal nutrition and its impact on biological stress systems in early life.

Early Nutrition and Stress Responses – Evidence From Animal Models

The bulk of the evidence for the programming effects of maternal undernutrition on HPA axis and ANS comes from animal studies. These studies have shown altered HPA axis functioning both in response to stress and during basal conditions. A study using guinea pigs showed that maternal nutrient restriction during the period of maximal fetal brain growth resulted in altered glucocorticoid receptor expression in fetal brain (43). Subsequently there were sex-specific alterations in glucocorticoid output in the adult offspring (44). Langley-Evans et al. showed that protein restriction in rat dams was associated with changes in several indices of HPA axis activity in the fetus (45). There was increased glucocorticoid receptor binding, and elevated corticosterone-inducible enzymes in higher brain centers, suggesting increased glucocorticoid sensitivity. Undernourishment of pregnant ewes during early gestation has been shown to increase cortisol and sympathetic-adrenal responses to stress in adult sheep offspring (46). In another study, maternal food restriction has been shown to alter HPA axis activity throughout the life course in rat offspring (47). This study showed reduced placental 11b-HSD2 activity and a greater trans-placental transfer of glucocorticoids in relation to severe maternal undernourishment. Further, there was altered stress responsiveness in later life and a state of chronic neuro-endocrinal hyperactivity in adulthood. In a rat model study, adult, non-hypertensive males born to protein-restricted dams were shown to exhibit stress-induced hyper-responsive blood pressure (48). A few animal studies also examined birth weight as a proxy for prenatal undernutrition in relation to indicators of HPA axis functioning. Klemcke et al. reported that low birth weight in pigs following unilateral hysterectomy resulted in a 70% increase in plasma cortisol in the low birth weight piglets (≤1.2 kg) at 3 days of age compared with the "large" birth weight piglets (>1.2 kg) (49).

One study among sheep showed that maternal over nutrition and obesity also influences offspring HPA axis sensitivity and responsiveness (50). Ovine models of pre-pregnancy maternal obesity and nutritional excesses were shown to increase fetal circulating cortisol concentrations compared to controls. Later in adult life, offspring of obese ewes had higher baseline plasma cortisol concentrations, and greater ACTH response to a hormonal challenge. This study gave the first indication of long-term effects of fetal exposure to over nutrition on stress reactivity.

Evidence From Human Studies

Evidence from human studies for an early programming effect of maternal nutritional status on biological stress systems in off spring, however, has been scarce. Initial studies on these associations examined cortisol levels in non-stressed state and used birth weight as a proxy for intrauterine nutrient deficiencies. In one of the early studies, Phillips et al. examined fasting plasma cortisol concentrations among elderly men born in Hertfordshire in the UK (51). The cortisol values were higher among subjects with a birth weight of 5.5 lb or less compared to those with a birth weight of 5.5 lb or more (408 nmol/L *vs*. 309 nmol/L, respectively). Findings from subsequent studies were inconsistent. However, a meta-analysis of published studies among Caucasian populations until 2004 showed a significant inverse association between birth weight and cortisol concentrations (~25 nmol/L per kg increase in birth weight) (52). The cortisol concentrations, in turn, were associated with higher systolic blood pressure, higher glucose and triglyceride concentrations, and insulin resistance. It was suggested that these findings reflect an association between lower birth weight and a heightened biological stress response (51). These researchers argued for the need to test dynamic responses to stressful situations to clearly understand the early programming effects.

Further studies in the UK and other parts of Europe did indeed show associations between birth weight and altered HPA axis and cardiac sympathetic stress responses. Wust and colleagues provided the preliminary evidence for associations between birth weight and adrenocortical response (53). In their study, 106 young male twins completed the Trier Social Stress Test (TSST), a standard psychosocial stress paradigm involving free speech and mental arithmetic tasks. This study showed that individuals with lower birth weights had a significantly higher salivary cortisol response to stress. This study expanded the earlier knowledge by showing a consistent effect of birth weight on adrenocortical responses in the face of moderate psychosocial stress. This finding was later replicated in children. Jones et al. observed that lower birth weight was associated with higher cortisol responses to the TSST in 7–9 year old children from Southampton, UK (54). This effect was seen only in boys, whereas in girls an inverse association was observed between birth weight and morning cortisol. Subsequently, *Kajantie et al.* demonstrated among older adults from the Helsinki Birth Cohort that birth weight had an inverse "U" shaped association where both lower and higher birth weights were associated with lower cortisol response to stress. This study suggested that intra-uterine conditions may program not only hyper-responsiveness, but also blunted HPA axis activity (55).

A few studies also observed altered cardiovascular reactivity to stress in relation to fetal growth retardation. One of the first studies of this association among 104 men and 79 women of ~26 years of age in Australia showed that systolic and diastolic blood pressure and heart rate responses to a standard psychological stress protocol were inversely correlated with birth weight but only in females (56). In contrast, in the study in Southampton children, lower birth weight was associated with greater resting systemic arterial pressure and higher vascular resistance response among boys (57). In girls, lower birth weight was associated with shorter resting pre-ejection period, but there was no association with stress responses. Adding to the evidence on sex-specific programming effects, among 8-year old children in Finland, girls were more likely to have higher systolic and diastolic blood pressure response and overall higher cardiac sympathetic activity in association with lower birth weight (58). They also had slower blood pressure recovery after stress. Boys had overall lower cardiac sympathetic activity.

Thus, though few, human studies have found a consistent association between early nutritional exposures (measured as birth weight) and indices of later neuro-endocrinal stress responses. Furthermore, initial evidence suggests sex-specific programming effects. In a systematic review of the early programming effects on HPA axis authors concluded that there seems to be an increased vulnerability among females particularly in terms of HPA axis reactivity (59). Other investigators exploring the effects of fetal programming on cognitive performance in infants too have observed sex-specific differences in outcome (60, 61). While the biological underpinning of differential sex programming effects are yet to be elucidated, it is suggested that this could be related to sex-dependent differences in placental function and epigenetic mechanisms(62). Furthermore, presence of sex hormones in the developing fetus may be related to the observed sex differences in outcome (61, 63).

Indian Scenario

India and other south Asian countries are experiencing a phenomenal rise in the prevalence of type 2 diabetes, cardiovascular disease, and other NCDs including depression. Nearly 80 million people in India alone are expected to develop type 2 diabetes by the year 2030 (1). Some investigators have described an Indian phenotype characterized by more total and truncal body fat than Caucasians of similar body weight, and lower lean body mass being linked to a rising prevalence of NCDs in India (64). This "thin-fat" phenotype itself has been thought to result from widespread fetal undernutrition, and recent economic transition resulting in enhanced postnatal growth. The incidence of GDM is also increasing rapidly among urban women, with estimated prevalence of ~15% currently (65). This, in addition to still widely prevalent maternal nutritional deficiencies, may create a double burden of intra-uterine undernutrition as well as overnutrition resulting in multiple programming effects on the growing fetus (64). However, the effects of early intrauterine nutritional environment on the development of stress mechanisms have been little studied in India.

The only studies in India on programming of stress responses as a risk factor for NCDs come from two birth cohorts in Mysore, India. In preliminary work in Mysore, morning cortisol concentrations were measured in a cohort of 500 adults of 40–60 years of age born in one maternity hospital (66). This study showed that cortisol concentrations were unrelated to birth size, but were strongly positively correlated with cardio-metabolic risk factors including blood pressure, plasma glucose, insulin resistance, and serum triglyceride concentrations. These correlations were stronger than those seen in white Caucasian populations and were amplified by (interacted with) adult adiposity. It was proposed that the high HPA axis activity and maintenance of high cortisol levels in the face of higher adiposity may be an underlying cause for increased cardiovascular risks in south Asian populations.

The above findings were subsequently replicated among the younger participants of Mysore Parthenon cohort (67). Similar to older adults, in the Mysore children (~9.5 years), higher fasting plasma cortisol was associated with contemporaneous cardio-metabolic risk markers. Unlike in the studies from the west, birth size was not a predictor of fasting cortisol concentrations. However, studies from the West showed that fetal programming effects on HPA axis is more apparent using dynamic stress testing procedures (53–58).

Maternal Gestational Diabetes Mellitus and Cardiovascular Stress Responses in Indian Adolescents

The above findings prompted the researchers in India to explore the association between maternal nutritional status and offspring stress responses using a dynamic stress paradigm. The only reported study of this association tested the role of intrauterine overnutrition related to maternal GDM in altered offspring stress responses (68). This study was conducted among participants of the Parthenon Cohort, a well-characterized birth cohort at Holdsworth Memorial Hospital in Mysore (69). This cohort was designed to examine the long-term associations of maternal GDM with offspring cardio-metabolic and mental health risks, and provides longitudinal data on this association. Initial investigations of this prospective study had shown that offspring born to GDM mothers were heavier and more adipose at birth, and exhibited greater adiposity, higher insulin resistance, and systolic blood pressure compared to control offspring (offspring born to non-GDM mothers and non-diabetic fathers) during childhood. The associations were less pronounced in offspring of diabetic fathers, thus emphasizing the additional risks associated with intra-uterine exposure to hyperglycemia over and above genetic predisposition.

When the participants were ~13.5 years of age, the Parthenon study examined their cortisol and cardiovascular responses to acute stress induced by the TSST for children (68). For the test, the adolescents completed 5-min each of a public speaking (imaginative story telling) and a mental arithmetic (serial subtraction) task in front of two unfamiliar adults acting as "judges" (stressor). Salivary samples were collected before and after the stress induction. Cardiovascular parameters were measured continuously before the test during neutral conditions (baseline) and during the stress induction as previously reported. Within the cohort, offspring of GDM mothers exhibited greater systolic blood pressure (5.6 mmHg higher than to controls), cardiac output (0.5 L/min), and stroke volume (4.0 ml) responses and a lower total peripheral response to stress (125 dyn s/cm5) than controls (68). The associations were not strong among offspring of diabetic fathers compared to controls. There was no association of parental hyperglycemia with cortisol responses to stress. The authors hypothesized that stress-response programming may be one of the pathways by which maternal overnutrition increases offspring NCD risk.

Maternal Micronutrient Status and Autonomic Nervous System Modulation in Children

Autonomic nervous system (ANS) is an important component of bodily stress response system and the HPA axis and ANS are considered as complimentary systems (70). The ANS has two components, the sympathetic and parasympathetic systems, which act in opposite directions. Maternal micronutrient deficiencies, particularly B group vitamins are common among pregnant women in India and studies have noted that maternal vitamin B12 deficiency is associated with adverse offspring outcomes (71, 72). Vitamin B12 plays an important role in myelination and its deficiency could impact myelination of ANS and alter its functioning. Heart rate variability (HRV) is widely used as a non-invasive measure of ANS modulation and is influenced by sympathetic and parasympathetic system (73). While fetal programming of ANS reactivity in children in relation to prenatal stress has been studied (74), few studies have examined the association between maternal nutrient status and ANS reactivity in children. In a study using HRV, severe vitamin B12 deficiency in adults was associated with decreased sympathetic component of ANS (75). A recent study noted that children born to mothers with low maternal vitamin B12 status during pregnancy had reduced cardiac sympathetic activity using indices of HRV (76). In a later study among pregnant women, women in the lowest quartile of vitamin B12 levels had deceased cardiac sympathetic activity as indexed by low frequency component of HRV compared to pregnant women with high vitamin B12 status (77). Reduced availability of vitamin B12 during pregnancy may affect the fetus through its effect on myelination and synaptic connectivity (78) and tissue levels of various neurotransmitters (79). While altered ANS functioning has been shown to be associated with increased risk for cardiovascular conditions in adults (80), it is not yet clear how changes in childhood HRV tracks into adulthood and whether it confers an increased risk for later development of cardiovascular system conditions.

Thus, longitudinal studies are required to fully understand the early programming effects on fetal and childhood ANS modulation and its implications for later development of NCDs.

Proposed Pathways Linking Prenatal Maternal Nutrition and Altered Stress Reactivity in Humans

A number of mechanisms have been proposed to underlie the early-nutritional programming of NCDs. The growing fetus depends on the mother for its nutritional needs, and it is not surprising, therefore, that any alteration in the maternal nutritional status or its supply to the *conceptus* will have an impact on the optimal fetal growth. It was suggested that when there is a poor nutritional supply, the growing fetus adapts to adverse conditions by prioritizing the growth of the brain, which is vital for survival, thus compromising the growth and functions of "less important" insulin sensitive organs like the pancreas, liver, and skeletal muscles (13). This prioritization could occur by redistribution of blood flow to vital organs, reduced secretion of anabolic hormones such as insulin and insulin-like growth factors (IGF), or increased cortisol production encouraging early differentiation and compromising abdominal visceral and musculo-skeletal growth. It is suggested that these organs "fail" to function in the face of later life metabolic load (e.g., adiposity) leading to disease (81).

Early epigenetic modifications may be another mechanism for early life programming. Epigenetic changes are heritable changes in gene expression without altering DNA sequence. These are established early during fetal growth and are influenced by environmental factors including maternal nutrition and metabolic status (82). Epigenetic modifications mediate differential phenotypic expression of a genotype, and thus may underlie the development of NCDs.

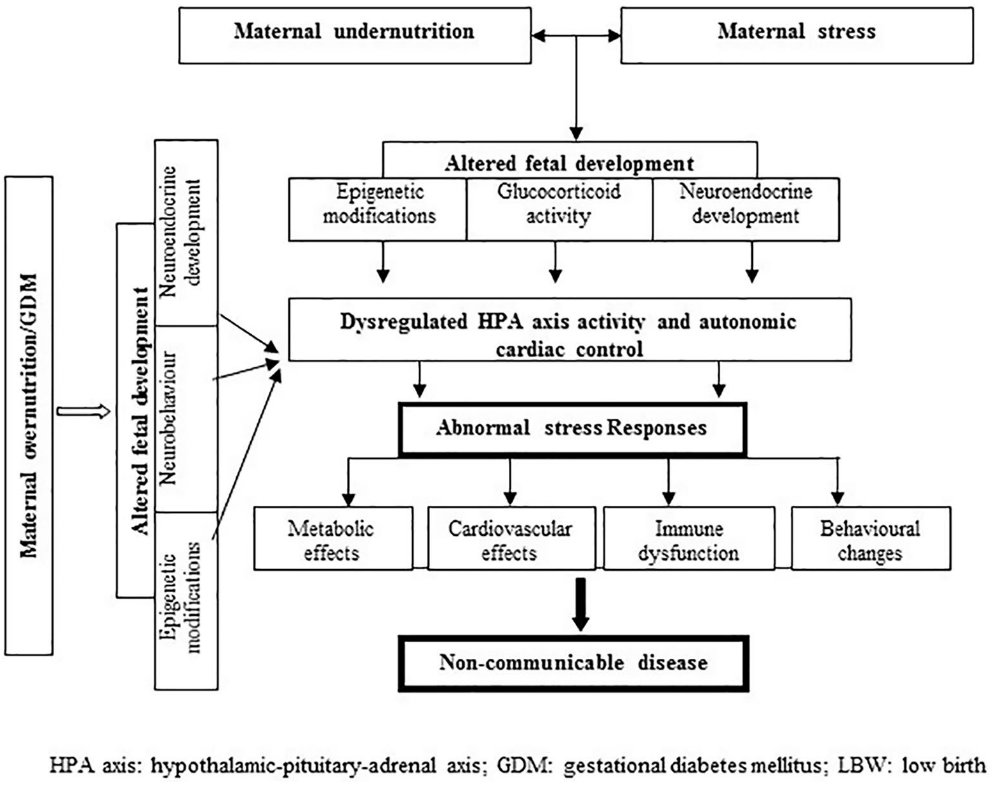
The above pathways may themselves also explain the link between maternal nutritional status and altered stress reactivity. Impaired intrauterine nutrition has been thought to induce permanent changes in the regulation and set point of several hormonal systems (83). In particular, maternal nutrition is thought to alter neuroendocrine structure and function. This has been proposed to impact HPA axis feedback systems through glucocorticoid receptors, and altered sympathetic-adrenal function. This results in altered responses of these systems. Triggering of epigenetic modifications, particularly DNA methylation of glucocorticoid receptors in brain have been thought to result in the persistence of altered functioning of these systems during later life (83). While maternal undernutrition may directly impact fetal programming of stress reactivity systems, it may additionally do so through its association with prenatal stress. It has been suggested that maternal diet during pregnancy may mediate the effects of prenatal stress on fetal programming (8). Others have noted that maternal stress acts as the mediator between dietary deficiencies during pregnancy and programming of the fetus (84) suggesting a bi-directional relationship between maternal stress and maternal nutrient status. Several studies have reported an association between unhealthy diet during pregnancy and maternal depression (85, 86), including increased fat intake in the first trimester (87) and decreased vitamin intake (88). Pregnancy specific anxiety has also been linked to poorer diet quality during pregnancy (89), less vitamin intake (90), and decreased omega 3 fatty acid intake (91). Animal studies have shown that high fat diet is associated with increase in maternal leptin, glucose, insulin, and pro-inflammatory cytokines (92, 93), which can impact fetal neuroendocrine development and HPA axis due to changes in the brain brought on by inflammation (8).

Mechanism for the association between maternal overnutrition and stress responses is not clear. Animal model studies have shown permanent changes in hypothalamic structure and function in relation to maternal diabetes (94); the stimulatory centers for both HPA axis and sympathetic nervous system are located in the hypothalamus. Maternal GDM may trigger DNA methylation changes as in states of nutritional deficiency (95). Perinatal hyperinsulinemia may also trigger anxiogenic behavior to stress in later life (96). **Figure 1** depicts the pathways described above.

Gap in Evidence—Future Plans

In India, maternal undernutrition and specific nutritional deficiencies may underlie the high prevalence of intra-uterine growth retardation and childhood undernourishment (97). On top of that, rising prevalence of adiposity and glucose intolerance among young pregnant women is exposing the growing fetus to dual insults of surplus fuel as well as specific nutrient imbalance *in utero*. Research from India and elsewhere suggest that this phenomenon may be a major triggering factor in the rapid escalation in the prevalence of type 2 diabetes and other NCDs in the country. Rapid urbanization in the country has introduced its own challenges in terms of energy-rich diets, decreased scope for physical activity, and increased life stresses, particularly among youth. This may further exacerbate the NCD and adverse mental health situation in the country (98, 99).

In this context, studying stress reactivity as mechanism linking early life nutrition with later development of NCDs, particularly in adolescents and young adults, may provide vital opportunities to intervene during key life course periods. However, despite a growing consensus on the importance of stress systems for later disease development, relationship of maternal nutritional status to offspring stress responses is yet to be clearly elucidated. Maternal nutrients, particularly B-vitamins involved in one-carbon metabolism are known to be vital co-factors in many neuro-developmental and gene methylation processes (100, 101). Findings from a recent



HPA axis: hypothalamic-pituitary-adrenal axis; GDM: gestational diabetes mellitus; LBW: low birth weight

FIGURE 1 | Proposed pathways linking prenatal maternal nutrition and altered stress reactivity in humans.

study in pregnant African American women showed that fatty acid supplementation resulted in lower cortisol reactivity to a laboratory stressor at 30 weeks of pregnancy (102). Thus, it is imperative that researchers working on DOHaD paradigm, particularly in countries in transition such as India, should embark on studies that clarify the way for future interventions. Specific issues are related to 1) the causal role of maternal nutrition in shaping stress responses in children, 2) mechanism underlying these associations, 3) critical life course periods during which interventions may optimize individuals' as well as future generation's stress responses for a better health, and finally 4) identifying suitable interventions for individuals who have already been exposed to sub-optimal nutritional status *in utero*.

These objectives form the premise for a recently launched multi-centric study in India (103). This proposed study aims to examine stress responses in adolescents and young adults in relation to various life course factors including maternal B12, folate and GDM, birth size, and childhood growth. By following up offspring of an existing pre-conceptional intervention cohort, this study provides a unique opportunity to test whether prenatal micronutrient supplementation optimizes physiological stress responses in adolescent children. A range of cardiometabolic parameters, psychological health indicators, and lifestyle factors are being measured. Mechanisms underlying programming of stress responses will be explored through structural brain MRI scans and epigenetics studies. The outcomes of this study are likely to fill some of the gaps identified above. Specifically, this will give robust evidence for the causal role of intra-uterine nutrition in programming stress responses in children and adolescents. Thus, intervention in life style factors that includes maternal diet during pregnancy linked to fetal metabolic programming may be a cost effective way to prevent future development of obesity, type 2 diabetes, and cardiovascular conditions (104).

CONCLUSION

In conclusion, it is apparent that, although animal studies have shown consistent association between impaired maternal nutritional status and offspring stress reactivity, research on programming effects among humans is in its early stages. Both animal studies as well as limited evidence in humans suggest that exposure to both undernutrition and overnutrition during fetal development may bring about adverse changes in stress response systems and functioning. This warrants that future studies on stress programming need to focus on both these aspects. Majority of the studies in humans have used birth weight as a proxy for fetal nutrition. However, birth weight is a crude indicator of fetal growth retardation, and does not give a complete estimation of the effects of fetal under nutrition on different physiological systems. Thus measuring offspring stress responses in relation to maternal nutritional status per se will give more objective measures of this association. However, to the best of our knowledge no such studies are available in humans currently, and this is definitely as area for future research. Moreover, causal relationships cannot be inferred by the observational studies and hence prenatal nutritional intervention studies may be an important step forward in this context. More studies adopting a similar approach from different parts of the world may provide robust evidence for the importance of adequate maternal nutrition in shaping optimal stress reactivity throughout life course.

AUTHOR CONTRIBUTIONS

Both the authors conceptualized the paper, contributed to the drafting and revising of the manuscript, and read and approved the final content.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

POLICY AND PRACTICE REVIEWS
published: 31 October 2019
doi: 10.3389/fpsyt.2019.00758

Reflections on "Building Back Better" Child and Adolescent Mental Health Care in a Low-Resource Postemergency Setting: The Case of Sierra Leone

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OPEN ACCESS

Edited by:
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Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Psychiatry

Received: *14 April 2019*
Accepted: *20 September 2019*
Published: *31 October 2019*

Citation:
Yoder - van den Brink HNC (2019) Reflections on "Building Back Better" Child and Adolescent Mental Health Care in a Low-Resource Postemergency Setting: The Case of Sierra Leone.
Front. Psychiatry 10:758.
doi: 10.3389/fpsyt.2019.00758

Over the past three decades, Sierra Leone has experienced two major humanitarian crises: an armed conflict (1991–2002) and an Ebola virus disease outbreak (2014–2015). In addition to these country-wide crises, the capital Freetown experienced a mudslide affecting thousands of people in 2017. In response to these emergencies, donors and aid organizations showed an increased interest in supporting and implementing mental health and psychosocial support interventions. Despite these efforts, the mental health infrastructure of the country remains frail. Specifically, systemic improvements in the implementation of evidence-based mental health care for children and adolescents appear to be lacking. In this article, the Interactive Systems Framework for Dissemination and Implementation is used as a tool to analyze issues related to the development of a sustainable, contextually relevant child and adolescent mental health-care delivery system. The author draws on her long-term experience as a child mental health specialist in Sierra Leone. Observations and hypotheses are tested and supplemented by formal and informal reports and national and international literature. The three systems described by the Interactive Systems Framework are explored in the context of Sierra Leone: (1) Synthesis and Translation, (2) Support, and (3) Delivery. Interaction between the three Systems is discussed as critical to the successful dissemination and implementation of interventions. Ample attention is given to contextual factors that are believed to be paramount to the development of child and adolescent mental health care in Sierra Leone. The article concludes with a reflection on the usefulness of the Interactive Systems Framework in the dissemination and implementation of child and adolescent mental health-care interventions in low-resource, postemergency settings. It is suggested that, in addition to funding and policies, the child and adolescent mental health system in Sierra Leone could benefit from the development of contextually relevant interventions, improvement of capacity-building efforts, and acknowledgment of the role of community-based practitioners in the delivery of services. Local mental health experts, especially those trained in child and adolescent mental health,

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Abbreviations: CAMH, Child and adolescent mental health; EVD, Ebola virus disease; ISF, Interactive Systems Framework; MHPSS, Mental health and psychosocial support; NGO, Nongovernmental organization; PFA, Psychological first aid; WHO, World Health Organization.

should be empowered to work together with culturally competent expatriate professionals to improve child and adolescent mental health care in Sierra Leone.

Keywords: Sierra Leone, children, adolescents, public mental health, postemergency, Interactive Systems Framework

INTRODUCTION

Around the world, lower- and middle-income countries are disproportionately affected by natural and manmade disasters (1, 2), [1] creating increased mental health needs in countries that often already have under-resourced mental health systems. In 2013, the World Health Organization (WHO) published the report "Building Back Better: Sustainable Mental Health Care after Emergencies" (3). The document argues that, while disasters create much adversity, humanitarian settings also present opportunities that are often lacking in regular development settings. The increased attention for mental health after an emergency often raises the interest of policy makers and increases the political will to make significant changes to the mental health system. Both national and international agencies frequently respond with increased resources to develop mental health and psychosocial support (MHPSS) services for the affected population. The "Building Back Better" report presents 10 lessons learned and key overlapping practices from areas that seized the opportunity to build quality and sustainable mental health systems in the aftermath of emergencies (see **Box 1**).

Over the past three decades, the West-African country Sierra Leone has experienced two major humanitarian crises: an armed conflict (1991–2002) and an Ebola virus disease (EVD) outbreak (2014–2015). In addition to these country-wide crises, the capital Freetown experienced a severe mudslide in 2017. In response to these emergencies, multiple donors and international aid organizations showed an increased interest in supporting and implementing MHPSS interventions. However, despite efforts to put the "Building Back Better" recommendations into practice (4), the mental health infrastructure of the country remains under-resourced to this date. Specifically, systemic improvements in the implementation of evidence-based mental health care for children and adolescents appear to be lacking.

BOX 1 | Building Back Better: Lessons Learnt and Key Overlapping Practices from 10 Low-Resource Settings.*

1. Mental health reform was supported through planning for long-term sustainability from the outset.
2. The broad mental health needs of the emergency-affected population were addressed.
3. The government's central role was respected.
4. National professionals played a key role.
5. Coordination across agencies was crucial.
6. Mental health reform involved review and revision of national policies and plans.
7. The mental health system was considered and strengthened as a whole.
8. Health workers were reorganized and trained.
9. Demonstration projects offered proof of concept and attracted further support and funds for mental health reform.
10. Advocacy helped maintain momentum for change.

*) World Health Organization. *Building back better: sustainable mental health care after emergencies.* Geneva: WHO (2003)

Children and adolescents make up a significant proportion of the population of Sierra Leone. Of the total population of seven million, ~42% is under the age of 14 years and ~60% is under the age of 25 years (5).[2] There are no epidemiological data on child and adolescent mental health (CAMH) in Sierra Leone. However, using prevalence rates from similar contexts, the treatment gap for this population is estimated to be 99.8–99.9% (6). Current specialized mental health services for children and adolescents are limited to one outpatient clinic at the Ola During Children's Hospital in the capital Freetown, where services are provided by a mental health nurse who was trained in CAMH in Nigeria (7, 8). Three other nurses and four medical doctors were trained through the same program but are yet to be deployed in this capacity by the Government of Sierra Leone (S.K. Conteh, personal communication, April 14, 2019). The 19 mental health nurses posted at the mental health units in district hospitals across the country received training in the Mental Health Gap Action Program (mhGAP) intervention guidelines (9), as did various other health professionals (7), but general supervision is minimal or absent and specialized supervision for services provided to children and adolescents unavailable. There are three psychiatrists (one expat) and two clinical psychologists who are mostly serving the adult population (M. van Leeuwen, personal communication, March 7, 2019).

In Sierra Leone, the Ministry of Health and Sanitation plays a central role in the governance of mental health-care delivery. To successfully implement comprehensive MHPSS services, they collaborate with other government ministries, most notably the Ministry of Social Welfare, Gender and Children's Affairs. Government efforts are supplemented by nongovernmental organizations (NGOs), which mainly provide psychosocial counselling, often for specific groups such as girls affected by gender-based violence or vulnerable youth.

There have been previous evaluations in different contexts of how building back better may have succeeded or not (10, 11). In this paper, I use the Interactive Systems Framework to conduct a systematic analysis of the apparent lack of success in building back better from a dissemination and implementation perspective (12) and make recommendations to strengthen the development of a relevant CAMH system.

APPROACH

Dissemination and implementation science is a relatively new field of study in global mental health which addresses the gap that often

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[1] https://www.preventionweb.net/risk/poverty-inequality

[2] https://www.cia.gov/library/publications/the-world-factbook/geos/sl.html

exists between evidence and practice. Dissemination refers to the methods or strategies that are used to transmit information on evidence-based interventions to end users, while implementation refers to the process of putting the evidence-based interventions into effect (12). The specific dissemination and implementation model applied here was selected from a review of 61 models for dissemination and implementation research by Tabak et al. (13). The Interactive Systems Framework (ISF) seemed to be most suitable for the purpose of the current analysis, as it is characterized by: (a) a broad construct flexibility (meaning it can be applied to a wide variety of dissemination and implementation contexts and activities), (b) an equal focus on dissemination and implementation, and (c) operation at multiple socioecological levels.

The Interactive Systems Framework was first described in 2008 by Wandersman and colleagues as "*a heuristic framework for organizing the theory, research, and practice (activities) of the dissemination/implementation process*" (14, p. 178). The ISF concentrates on three 'Systems' that work together to disseminate and implement interventions: (a) the Synthesis and Translation System, (b) the Support System and (c) the Delivery System. The three Systems are characterized by activities rather than specific organizations or individuals.

The focus of activities within the "Synthesis and Translation System" is on translating scientific information generated through research into understandable and actionable information to be used by practitioners. The ISF does not prescribe the method used for this, but a collaborative effort of both researchers and end users is recommended (14). The "*Support System*" *carries out two support functions: (a) general capacity building ("intended to enhance the infrastructure, skills and motivation*" (14, p.175)) and (b) intervention-specific support (related to the implementation of a specific intervention). The "Delivery System" refers to activities focused on implementation. The individuals or organizations implementing mental health activities may have varying degrees of (a) general capacities (the skills to maintain a functioning organization and the capacity to connect with other organizations and the community) and (b) intervention-specific capacities (activities like identifying, implementing, and continuing interventions) (14). For the successful dissemination and implementation of interventions, it is essential that the three Systems work well together, communicating information and knowledge back and forth. The three Systems of the ISF are embedded in a wider context which is considered important but is not the main focus of the original framework (14). The developers identified the context elements of Existing Research and Theory, Climate, Funding, and Macro Policy. For the purpose of this paper, we describe "climate" as the historical, socio-political, mental health and cultural climate. **Figure 1** shows a visual representation of the ISF.

According to the developers, the ISF is primarily descriptive but is also meant to improve the dissemination and implementation process (14). While initially developed for the field of primary prevention, the ISF has also been applied in the fields of secondary and tertiary prevention in health and mental health (15–18). In 2018, it was for the first time successfully used in a low-resource context (19). As far as I am aware, it has never before been used to analyze a countrywide mental health system with the aim to improve the dissemination and implementation of CAMH interventions for an entire population.

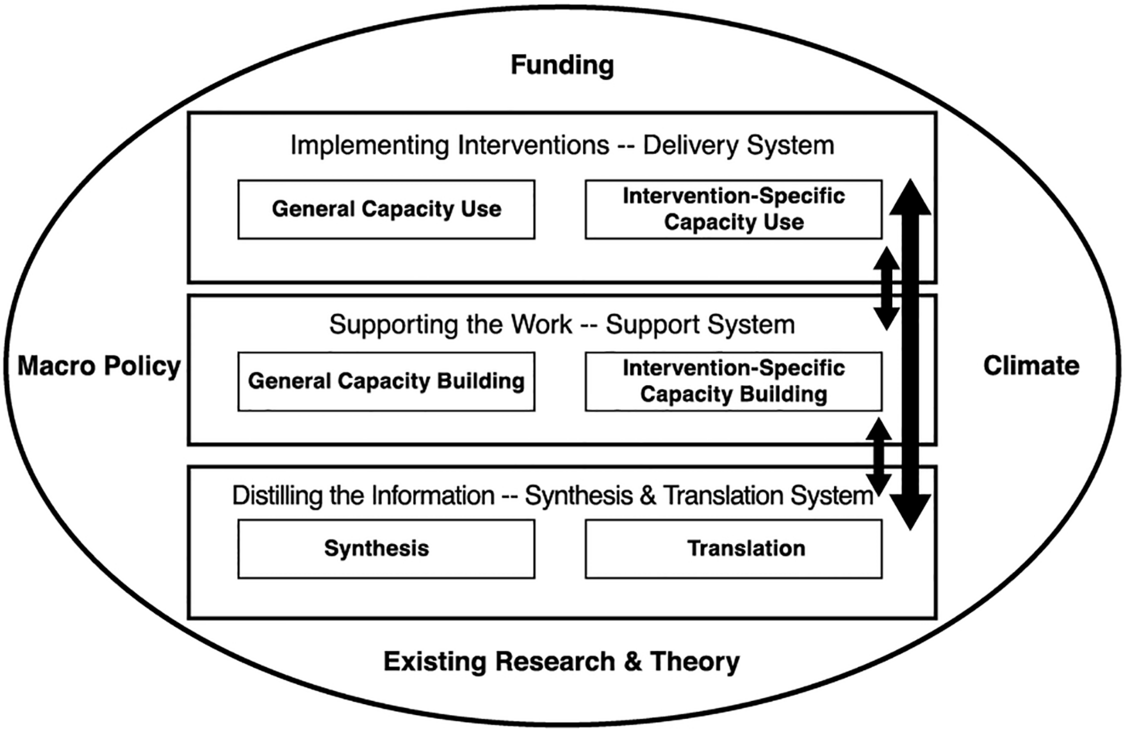

FIGURE 1 | The Interactive Systems Framework (14).

For the analysis in this paper, I draw on my experience as an expatriate child mental health specialist in Sierra Leone (approximately 13 years over a period of 16 years). Observations and hypotheses following from this experience are tested and supplemented by both formal and informal reports and national and international literature on mental health-care development and delivery.

In the subsequent paragraphs I will first describe and analyze contextual factors, followed by an exploration of the three "Systems" within the ISF in Sierra Leone. The description of each System will include an analysis of the current situation and recommendations for System strengthening. An important aspect of the ISF concerns interaction between the three different Systems in the model. This will be addressed in the last paragraph, before a description of strengths and limitations of my approach and conclusions and recommendations.

CONTEXT

Although contextual factors are literally placed on the periphery of the ISF (20), I believe they are paramount in understanding the development of CAMH care in Sierra Leone (cf. 21) and will therefore give more weight to contextual factors in my application of the ISF model.

Climate

History and Sociopolitical Factors

The long-term history of Sierra Leone is deeply influenced by the slave trade. Many slaves in Europe and the USA originated from Sierra Leone. In 1787, after the abolition of slavery in the UK, a British naval base was established in Freetown in an effort to combat the slave trade and to provide a settlement for freed slaves (22).[3] In 1961, the country gained independence from the UK, which had colonized the country since the early nineteenth century. Sierra Leone's current population consists of 2 larger and 14 smaller ethnic groups. The two main religions are Islam (71%) and Christianity (27%) (23).[4] From 1991 to 2002, the country was affected by a brutal armed conflict, caused by a complexity of factors including inadequate governance (24) and, as some argue, the marginalization of youth (25). The country's rich diamond mines were sought after by many parties, persistently fueling the conflict (24). Approximately 50,000 people were killed, and more than half of the population was displaced (26). Many people were affected by human rights atrocities such as sexual violence and the amputations of limbs (27). It is estimated that nearly 7,000 children were recruited as child soldiers (28). The conflict affected and continues to affect the mental health of people across generations (29–31). In the 2014–2015 EVD outbreak, over 8,700 people were diagnosed with the disease, and nearly 4,000 died (32)[5]. The outbreak had a deep impact on the children of Sierra Leone. Participatory research with children across nine districts identified the closure of schools as their primary concern. Other concerns included the varied effects Ebola had on their lives (such as fear, anxiety, and grief), the reduced access to health care for other health problems, and the broader economic impact of the outbreak. The school closure was also believed to have led to an increase in child labor, exposure to violence, and teenage pregnancy (33). As the country's health infrastructure was disrupted, many children failed to get their vaccinations (34), potentially increasing the spread of communicable diseases. In August 2017, a large landslide near the capital Freetown slipped into a river valley, exacerbating existing flooding in Freetown and surroundings. Approximately 6,000 people were affected, of which 1,141 were declared dead or missing. The disaster caused major damage and loss, affecting housing, infrastructure, health, sanitation, and education (35). Although no epidemiological data are available, it is safe to assume that the multiple crises and daily stressors related to poverty [over 60% of the population live below the national poverty line (36)[6]] have affected the mental health of the population in varying degrees (37, 38). Additionally, malaria, which is highly prevalent in Sierra Leone, increases the risk of developmental, cognitive, or behavioral disorders in children (39–41). Substance abuse and related mental disorders are frequently mentioned as a significant and possibly growing risk for adolescents in Sierra Leone (6, 42). Mental health issues related to gender-based violence are a concern for girl children. Accurate data are lacking, but in 2019, the President of Sierra Leone declared rape and sexual violence a national emergency (43).[7]

Mental Health Developments

At the end of the armed conflict, the country's mental health system consisted of one psychiatric hospital, which dated back to the colonial days, and one psychiatrist. The years that followed were marked by strained relationships between national and expatriate actors in mental health. The only psychiatrist, who was also the Director of Mental Health Services at the Ministry of Health and Sanitation, for a while refused to work with the local and regional offices of the WHO and deeply distrusted the agenda of international NGOs (44), although this last issue was probably not unique for the mental health sector.

> *Example: In the years after the war, it was common to hear people comment: "Those NGO people, they only drive around in their big vehicles, but we don't see any results of what they are doing."*

A strong emphasis on the uniqueness of "African psychiatry" was used to keep expat mental health professionals at a distance. In turn, expat professionals seemed to have a lack of cultural understanding which affected their interactions with the government (44). Over the years, new actors were added to the scene, relationships seemed to improve, interest in mental health increased, and important strides towards development were made. However, in an evaluation of the EVD outbreak MHPSS response in 2015, a significant critique still concerned the dominance of international organizations in mental health intervention decision making, leading to culturally insensitive work and a disenfranchisement of national actors (4). As Bah and

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[3] https://unipsil.unmissions.org/about-sierra-leone-history

[4] http://worldpopulationreview.com/countries/sierra-leone-population/

[5] https://www.cdc.gov/vhf/ebola/history/2014-2016-outbreak/index.html

[6] http://www.sl.undp.org/content/sierraleone/en/home/countryinfo.html

[7] https://statehouse.gov.sl/president-julius-maada-bio-declares-rape-and-sexual-violence-as-a-national-emergency-in-sierra-leone/

colleagues observe, many postemergency MHPSS interventions *"remain relatively top–down and external. They focus on a very specific population and are often not well integrated into the health system at national, district and primary levels. This means that even those which have been well-evaluated have had a limited impact on the overall mental health and psychosocial wellbeing of the population of Sierra Leone"* (7, p. 44).

Cultural Factors

In the context of this paper, I will not attempt to give a comprehensive overview of the cultural values, practices, and beliefs that affect CAMH care development in Sierra Leone, especially when considering the diversity of cultures within the country. Nevertheless, four important aspects that should be highlighted are the following: (a) the importance of religion in mental health perceptions and help-seeking behavior (6), (b) the notion that mental health is commonly perceived as a collective issue rather than a personal one (44), (c) the stigma attached to mental health problems in Sierra Leone, which affects both people with mental disorders and those living or working with them (6, 45), and (d) the low status that children hold in Sierra Leone society (46), which may affect the priority given to child mental health.

Macro Policy

Mental health care in Sierra Leone is guided by legally binding acts and government policies and strategic plans. The "Lunacy Act" (47), which dates back to the colonial days, is outdated and may contribute to alienation and discrimination of people with mental health problems (45). Its revision has been planned for many years but has not yet materialized. The first Mental Health Policy was launched in 2012 (48) but, according to Bah and colleagues, had minimal practical impact (7). A new Mental Health Policy was launched in 2019 (49). Although the Policy is an important condition for mental health development, the single reference to children as a "*special population*" (49, p. 6) and the absence of any reference to adolescents do not do justice to a group which makes up at least 50% of the population. After the EVD outbreak, the Ministry of Social Welfare, Gender and Children's Affairs developed the MHPSS services packages, which describe the services that should be offered to all persons affected by crises, with a particular focus on children (50). The 2015–2018 MHPSS Strategy of the Ministry of Social Welfare, Gender and Children's Affairs is currently under review. The Persons with Disability Act describes the rights and privileges of persons with disability, including those with mental impairments (51). According to this act, children should be screened for early signs of disabilities at health centers, and children with disabilities should have access to education and free health care. While some progress has been made towards these goals, in many areas the implementation is found deficient and hindered by a lack of referral systems (6).

Funding

One of the most limiting factors in mental health-care development in Sierra Leone is funding (45, 52). Despite the increased interest in MHPSS after the EVD outbreak, there is no separate budget line for mental health in the budget of the Ministry of Health and Sanitation (7). Similarly, the Ministry of Social Welfare, Gender and Children's Affairs depends exclusively on outside donors for the implementation of their MHPSS activities (J.A. Duncan, personal communication, July 30, 2019). Although international NGOs are often willing to invest in short-term psychosocial intervention projects, very few invest in the treatment and care of those who need specialized and prolonged mental health care (44). After the EVD outbreak, it was observed that the emphasis had been on care for Ebola survivors at the cost of resources for general population-wide mental health services (53). To date, the majority of health personnel trained in mental health (including CAMH) is not receiving increased monetary benefits, causing many to divert either part or full time to other areas of health care (M. van Leeuwen, personal communication, March 7, 2019).

Existing Research and Theory

The existing research and theory that inform CAMH in Sierra Leone include international guidelines and studies on postdisaster MHPSS interventions and mental health research carried out in Sierra Leone. In the Introduction, I already mentioned the WHO "Building Back Better" document (3). Many of the post-Ebola interventions were guided by the IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings (54), the Mental Health and Psychosocial Support in Ebola Virus Disease Outbreaks: A Guide for Public Health Programme Planners (55), and the "Psychological First Aid during Ebola Virus Disease Outbreaks" manual (56). To guide general CAMH across the globe, the WHO published their "Caring for Children and Adolescents with Mental Disorders: Setting WHO Directions" (57). There is also a growing body of research on the effectiveness of CAMH interventions in low-resource humanitarian settings (58–61) and the dissemination and implementation of evidence-based mental health interventions in low-income countries (12, 62–64). With a few exceptions, the majority of CAMH research in Sierra Leone concentrates on children affected by the armed conflict or associated with the armed forces (6). However, valuable lessons can be learned from these and other studies in relation to cultural adaptation and the implementation of CAMH services for a variety of needs. This will be discussed in the next paragraph.

DISTILLING THE INFORMATION—SYNTHESIS AND TRANSLATION SYSTEM

In the field of global mental health, and MHPSS in humanitarian settings specifically, authors have noted major gaps in the synthesis and translation process (65–68). One assumed important aspect of the synthesis process is to identify core elements that appear to be responsible for an intervention's effectiveness and which after adaptation will have to be implemented with fidelity to the original design (14). This is particularly challenging when translating knowledge originating primarily from Western, high-income countries to interventions that are feasible and relevant for children and adolescents in settings with low resources and different belief systems (69).

Locally Relevant Synthesis and Translation Activities

Examples of synthesis and translation activities that have been particularly relevant for CAMH in Sierra Leone are the development of a Psychological First Aid (PFA) manual for EVD outbreaks by the WHO and several international NGOs (56) and a training manual for delivering PFA to Ebola-effected communities in Sierra Leone (70). While the PFA manual of the WHO gives ample attention to children and adolescents, the training manual on PFA for Sierra Leone has a strong bias towards adults, thus neglecting a significant part of the population. The manual has a section on "Tips/skills for good communication with children," but the suggestions listed there are not specific for children and adolescents and important issues such as communication through play or art are missing. The list of stress symptoms provided does not include symptoms of stress common in children or adolescents, such as regressive behavior and changes in play in younger children, or acting out among adolescents. A training manual on basic psychosocial support in education published by the Ministry of Education, Science and Technology of Sierra Leone (71), however, contains an abundance of practical information on psychosocial strategies for children and adolescents in the classroom setting. Both locally adapted manuals do address the issue of shame, a complicated emotion which the author has found to be very prevalent in Sierra Leone and often overlooked and poorly understood by outsiders. Shame was also identified by one organization as a frequently cited MHPSS problem during the EVD outbreak (72). Lastly, a "Toolkit for Community PSS Workers" with accompanying Information Guide was developed by the international NGO Trocaire with members of the Psychosocial Support Working Group in Sierra Leone (50, 73). The strength of the Toolkit is that it was developed with local partners, but its usefulness is limited by the overemphasis on relaxation exercises (11 out of 23 tools) and the possible lack of fidelity to original interventions. For example, a narrative therapy intervention aiming at resilience building, which originally was designed to last at least 8 h, was reduced to a 45- to 60-min intervention with significant changes to important components (74). With the increased interest in a resilience approach in MHPSS interventions, the Resilience Measure for Children and Youth is an interesting tool which deserves to be further explored for use in Sierra Leone. Currently, it is not clear to what extent the tool has been adapted and tested in Sierra Leone, an extremely important process considering the complexity of the concept of resilience (75). It should be noted here that not all MHPSS strategies and interventions in the discussed documents have been tested for cultural relevance and effectiveness in Sierra Leone, which limits their value in terms of evidence-based practice.

Cultural and Power Differences

Including end users in the translation process, as recommended by the ISF, needs to be done with sensitivity to the culture and with cognizance of the power differences between international organizations and local experts and the local community.

> *Example: An international aid worker in the EVD outbreak response, with no previous experience in Sierra Leone and representing an organization with a significant budget, proposed a guided imagery exercise for children in which they imagine to be an animal. When she was told that this concept may not be appropriate in a culture where it is not uncommon for vulnerable children to be accused of changing into animals for witchcraft purposes, she was surprised that she had received no such feedback from the local authorities who gave permission for her work.*

It is possible that, similar to other contexts (76, 77), power differences in Sierra Leone are not just monetary or knowledge related but that there is also a deep-seated belief in many Sierra Leoneans themselves that their views are inferior to those of international workers, especially white expatriates. It is plausible that this belief dates back to the days of slavery and colonialism and has been reinforced by dependence on international aid over the last few decades.

> *Example: Participants in a workshop were given pictures of people of different age, race, and socioeconomic status and were asked to rank them according to their "value." The young white female was outranked only by the president.*

Empowerment of local experts is therefore an important process which requires time and sensitivity and which should be an integral aspect of mental health system development.

Strengthening the CAMH Synthesis and Translation System

There are several things that can be done to strengthen the synthesis and translation system for CAMH in Sierra Leone: (a) Existing literature should be reviewed for culturally relevant tools, cultural themes, and recommendations that can inform and strengthen new CAMH interventions. **Table 1** gives a few examples identified by the author in a rapid informal review of literature on CAMH-related issues in Sierra Leone (6, 78–85). (b) Research from related fields should be reviewed for cross-cutting issues. For example, the Columbia Group for Children in Adversity conducted an ethnographic study in Sierra Leone on community-based child protection mechanisms, which includes information relevant to the development of MHPSS interventions for children and adolescents. Examples are views of childhood (e.g., children are defined in relational terms; young people who become sexually active are considered adults), power asymmetry in the implementation of interventions, and practical lessons learnt in relation to capacity building and logistics (86). (c) Input from end users should be improved with sensitivity to power relations and culture. Local professionals, especially

TABLE 1 | Examples of relevant themes, tools, and recommendations.

Category	Description	Study
Theme	The importance of religion in mental health.	Stark (78) Behrendt (79) Yoder et al. (6)
Theme	Minimal evidence of reflecting on past. A desire to move on after trauma. Difficulty in verbal processing.	Burman & McKay (80)
Theme	Avoidance of emotional vulnerability.	Harris (81)
Recommendation	MHPSS interventions should address the specific needs of girl children.	Behrendt (79)
Recommendation	Apart from PTSD, also treat affect recognition, self-regulation and social engagement.	Ardizzi et al. (82) See also Betancourt (83)
Recommendation	Findings suggest that the inclusion of family-based elements will increase the impact of MHPSS interventions with adolescents.	Betancourt et al. (84)
Tools	The following tools were translated and tested for use with adolescents in Sierra Leone: Oxford Measure of Psychosocial Adjustment, World Health Organization Quality of Life-BREF instrument, Difficulties in Emotion Regulation Scale.	Newnham et al. (85)

those trained in CAMH, should be empowered in the field of synthesis and translation. (d) Together with end users, topics should be identified for further research and fed back to the research community. An example of this could be the exploration of shame as an important emotion in the context of mental health.

SUPPORTING THE WORK—SUPPORT SYSTEM

The support system carries out both innovation-specific and general capacity building.

Innovation-Specific Capacity Building

Examples of innovation-specific support in Sierra Leone are the training of the government and NGO workers in postemergency interventions such as PFA, the training of personnel on various levels of the health system in the mhGAP Intervention Guide (9, 87),[8] and short-term mental health training by international organizations or institutions with MHPSS projects in Sierra Leone. A popular international training concept that is also often used in Sierra Leone is the "training of trainers" approach, where participants in a training event are expected to replicate the training in their own environment (88). The author is not aware of any research done on the training of trainers concept in Sierra Leone in terms of replication, fidelity to the original design, and efficacy or effectiveness. However, the local practice of paying people for attending training (usually in the form of a generous travel stipend and provision of food and lodging) may limit the probability that training will be replicated, as few local organizations will have the funds to pay participants.

Ray et al., who studied the support system of the ISF in the context of evidence-based prevention projects, describe how literature increasingly shows that training by itself is not sufficient to ensure quality implementation and that it should be accompanied by ongoing tailored support of those who participated in the training (88).While many organizations provide short-term MHPSS training in Sierra Leone, there is frequently no sufficient follow-up in the form of ongoing coaching or supervision (52), nor are there clear guidelines for supervision in terms of qualifications of the supervisor, frequency and method of supervision, etc. (89). This is often because of a lack of funding or human resources. This is especially a concern in clinical mental health, where practicing skills under the supervision of a senior professional is a crucial aspect of training (90, 91). An example of how this could be done is the apprenticeship model for the training of local providers of mental health interventions as described by Murray et al. (92).

General Capacity Building

In the aftermath of emergencies in Sierra Leone, the emphasis has often been on innovation-specific capacity building. However, as Noonan and colleagues point out, while innovation-specific capacity building is important, by itself it does not predict sustainability. The general capacity of the organization or setting in which the intervention is embedded may be even more important for its continuation (93). General capacity building, which is described by Wandersman and colleagues as intended to improve "*infrastructure, skills and motivation*" (14, p. 175), has often been overlooked.

A successful project aimed at general capacity building has been the Mental Health Leadership and Action Program, which was launched in 2010 in the five Anglophone countries in West Africa, including Sierra Leone. The program trains people from various professional backgrounds in mental health leadership and advocacy (building skills and motivation) and supports the establishment of stakeholders councils (building infrastructure) (94). In Sierra Leone, the program supports the Mental Health Coalition, an advocacy organization bringing together stakeholders including service users, practitioners, national and international NGOs, civil society, traditional healers, researchers, and human rights organizations (45, 95).[9] Despite the general success of the Mental Health Leadership and Action Program and the Mental Health Coalition in advocacy for mental health, neither program has been able to successfully address the lack of government attention to CAMH.

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[8] https://afro.who.int/news/improving-access-mental-health-services-sierra-leone

[9] https://mentalhealthcoalitionsl.com/

The Youth Forward intervention, developed by Betancourt and colleagues following 15 years of longitudinal research on the mental health of young people affected by the armed conflict in Sierra Leone, is a promising example of a CAMH intervention, which takes both innovation-specific and general capacity building into account (83). The program is an attempt to scale up the Youth Readiness Intervention, which was developed for war-affected youth, and will be implemented as an integrated part of a youth employment program. It recognizes the need to move away from remote expertise and to cultivate local knowledge using a collaborative approach to develop a core of local experts across agencies. Apart from innovation-specific knowledge, the core team develops "*critical skills related to collaboration, leadership, communication and quality improvement*" (83, p. 32). The effectiveness of this approach has not yet been evaluated. If successful, it could be an interesting model to be replicated, possibly in other sectors, as it remains to be seen how sustainable mental health initiatives in the employment sector will be.

Educational Challenges

Any activity within the support system in Sierra Leone is affected by the country's educational system which, from primary to tertiary level, has been severely affected by the armed conflict and again by the EVD outbreak. Large numbers of teachers do not have educational qualifications (96). At both primary and secondary levels, learning outcomes are often threatened by poor basic literacy and numeracy skills and factors such as absenteeism and large class sizes (97). The author has noticed that many students in tertiary education have limited access to academic resources. While many people are eager to learn, the general lack of quality education frequently affects their ability to benefit from certain forms of training.

> *Example: During a workshop people were divided into smaller groups and given case studies to read and discuss. The case study described a familiar local situation. The author, who participated in the workshop, found herself in a small group with a school administrator and a teacher. Both struggled to read the full-page story and needed additional time to read it again for full comprehension.*

Shackman and Price, in their evaluation of a mental health project in rural Sierra Leone, describe how the course level of the project had to be adjusted for participants with lower literacy skills, affecting outcomes related to capacity (98). One of the requirements for the 18-month diploma course for mental health nurses at the College of Medicine and Allied Health Sciences in Freetown is to have at least five credits (50–64%) on the West African Senior School Certificate, a prerequisite that many struggle to fulfill. There are differing opinions on whether the college should lower its requirements or whether it is better to train less mental health nurses with better qualifications. (H. Lind, personal communication, April 4, 2019).

Strengthening the CAMH Support System

Based on the above observations and earlier research (6), I recommend that the following measures are taken to strengthen the CAMH Support System in Sierra Leone: (a) The basics of CAMH should be integrated into the curricula of all health workers, thus increasing general awareness in the health system as a whole. (b) Those with interest in CAMH should have local access to specialized training. (c) Health professionals trained in CAMH should be empowered to educate other health professionals. (d) CAMH training should be practical and followed by systematic supervision. (e) Without compromising educational standards, training programs should cater to the educational levels of trainees, which may require an extended timeframe. (f) To promote inclusion of CAMH in policy and programming, leaders and policy makers in mental health should be made aware of CAMH needs and be trained in a life-course approach to mental health service development (99). (g) Organizations that are planning CAMH interventions in Sierra Leone should acquaint themselves at an early stage with general capacity needs of the setting in which the intervention will be implemented. If needed, provision should be made for general capacity building. (h) Training methods should be evaluated for their effectiveness in Sierra Leone.

IMPLEMENTING INTERVENTIONS—DELIVERY SYSTEM

The delivery of MHPSS services for children and adolescents may take place at different levels, from community-based services to specialized care at a national level, as described in the WHO Pyramid Framework (100). Similar to the support system, the delivery system is characterized by innovation-specific and general capacities.

Intervention-Specific Capacity

Intervention-specific capacity for children and adolescents in Sierra Leone is mostly limited to psychosocial support on the community level, which is usually provided by national or international NGOs, and often disproportionately directed towards the Western (urban) areas of Sierra Leone, as was noted in the EVD MHPSS response (4). While important, the author has observed that many of these interventions are dependent on donor funding and not integrated in the health, educational, or religious systems of the country—as seen in other humanitarian settings (67). This limits their sustainability. On the district level, government mental health nurses and a limited number of community health officers and medical doctors trained in the mhGAP Intervention Guide, in an effort to task share (101), should be able to provide care for children and adolescents with emotional, behavioral, or developmental disorders. However, the quality of care these health workers can provide may not be adequate due to the limited training they have received in CAMH and the absence of specialized supervision. Most childhood disorders, especially in younger children, are recommended to be managed without pharmacological treatment, especially in nonspecialist settings (9). Psychological interventions for children and adolescents require professional skills that likely take more time to learn and develop than most short courses can offer. They also require more patient contact time than most health-care workers at this level can offer, as the majority of them are expected to fulfill their other duties in health care as well. In the opinion of the author, this could be a limiting factor of the task-sharing model, which will affect its applicability in the CAMH sector. For people living outside the capital, travel distance and expenses make it nearly impossible to attend the country's only CAMH clinic at the children's hospital in Freetown.

General Capacity

The general capacity of the delivery system refers to the capacity to maintain a functioning organization and to connect with other organizations and the community. The aforementioned educational situation in Sierra Leone may be a limiting factor for the general capacity in some organizations. In their evaluation of a mental health project, Shackman & Price (98) describe concerns related to program management, such as issues with day-to-day management, record keeping, report writing, liaising with other agencies, representation of the program at a senior level, monitoring and evaluation, etc.

Another major issue in the general capacity of the delivery system is the difficulty in retaining personnel. Local capacity gets depleted when personnel trained by NGOs in MHPSS do not find similar employment after the NGO's activities are closed down (44, 98). We already mentioned that many mental health nurses are finding alternative employment, as the government has not yet accredited their training or increased their benefits and only one out of the eight people trained in CAMH is currently employed in a relevant position.

Relationship With the Community

General capacity also refers to the capacity to relate to the community in which the intervention takes place. For interventions to be successful, it is important that the community owns and supports the intervention and makes appropriate referrals. Furthermore, there are actors in the community that may not be considered part of the professional workforce but that nevertheless play an important role in providing care. Kleinman describes these as the popular sector (individual, family, and community) and the folk sector (nonprofessional healing specialists) (102). In Sierra Leone, the last sector is represented by religious institutions such as churches and mosques and traditional healers. In her research on psychosocial needs of children without parental support in the eastern district of Kailahun after the armed conflict, Behrendt noted that many children found consolation in faith and faith-related activities (79). In line with local explanatory views which explain child mental disorders mostly in spiritual or supernatural terms, parents of children with mental health problems usually seek help from Christian healing ministries or traditional (often Muslim) healers. Owing to their large numbers, they are also more accessible than formal mental health-care services (6). It is the author's impression that there is less stigma attached to seeking help from religious leaders than from mental health professionals. The relationship between professional mental health care providers and traditional or religious care providers in Sierra Leone, however, remains complex and in need of further exploration (98). While nonprofessional practitioners are accepted by the community and may have good intentions, their treatments are generally costly and frequently include harmful practices (6, 7).

> *Example: A 5-year-old with symptoms of potential autism spectrum disorder presented to the hospital with burn scars on his abdomen, which were sustained during a healing ritual by a traditional healer.*

> *Example: Children who are felt to be witches (often based on their deviant behavior) are submitted to extended periods of "dry fasting" (fasting from food and liquids) before being "delivered from evil forces" at a church camp.*

Despite reservations related to abusive practices, the important role of the faith-based healers cannot be denied, and for this role to be adequately studied and utilized, the actors deserve a recognized place in the delivery system. I will come back to this in the Discussion.

Support from the community and community-based practitioners is also important to address stigma.

> *Example: A child with brain injury due to malaria regularly receives beatings from community members as she unintentionally picks up their belongings and misplaces them.*

> *Example: Neighbors tell a boy with cerebral palsy not to look at them for fear that eye contact with him may negatively affect their wellbeing. His family has to move frequently until the mother is able to build a small home on the outskirts of town.*

Addressing stigma in the community is one aspect of an ecological approach which increasingly is considered to be preferential to an individual approach in MHPSS interventions for children and adolescents (54, 69, 103, 104).

Measuring Effectiveness

To evaluate the effectiveness of CAMH interventions, there is a need for robust measurements that consider context and culture.

> *Example: During the EVD outbreak, an international NGO performed a baseline assessment of the psychosocial wellbeing of a group of children before testing an intervention. The children were occupying desks in a classroom, with their parents sitting at the back of the room. When the NGO worker called out the various questions and asked the children to rate their experiences on a 1–10 scale, the parents called out to their children: "Write 7!," "Write 5!" etc.*

Possibly influenced by earlier encounters with relief organizations in the context of emergencies, the parents seemed to expect that the benefits to be received from the NGO would be influenced by their child's answers to the survey.

For CAMH interventions to be relevant to the culture, effectiveness should also be measured in a way that reflects cultural values. In their article on girls formerly associated with armed forces in Sierra Leone, Stark and colleagues (105) remind us that in many African contexts "*physical and mental health are often conceived of in relation to one's environment, one's ancestors and one's relationship with others*…" (105, p. 4). Stark describes how participatory ranking was used to develop culturally relevant indicators for reintegration and well-being. Similar methods could be used to develop indicators for the effectiveness of new and existing CAMH interventions.

Strengthening the CAMH Delivery System

The CAMH delivery system can be strengthened in various ways: (a) Organizations implementing MHPSS interventions for children and adolescents should be encouraged to integrate their activities into existing structures for sustainability. (b) Health workers trained in CAMH should be accredited and deployed across the country, thus decentralizing care. (c) Relationships between formal providers and the community should be strengthened to reduce stigma and abuse and promote adequate and mutual referrals. (d) CAMH interventions should be evaluated with robust measurements that are sensitive to the context and culture.

INTERACTIONS

For innovations to be successfully disseminated and implemented, interaction between the three systems of the ISF is crucial.

> *Example: The Toolkit for PSS workers was developed by multiple MHPSS partners soon after the EVD outbreak. About a year later, the landslide near Freetown took place, affecting thousands of people in the Western Area. A CAMH expert who participated in the MHPSS coordination meetings recalled that the Toolkit was never mentioned as a potential resource for interventions. She herself only found out about the Toolkit another year later.*

One of the distinctive features of the ISF is that it acknowledges the importance of a two-way flow of information rather than a top–down approach from research to practice (106). The interaction between the three systems is probably the least investigated aspect of the ISF, but could potentially be just as or even more important than the three individual systems (15).

In Sierra Leone, the different Systems in the dissemination and implementation process are separated by more than the typical differences in professional viewpoints and capacities. The Synthesis and Translation System and the Support System are dominated by international aid and relief organizations and experts, while the Delivery System consists mostly of local practitioners, who are often employed by the local government or local institutions. Interactions between the Systems are therefore also influenced by differences in cultural backgrounds, belief systems, goals, and expectations. For example, objective evaluation of trainings or interventions can be complicated by the fear of losing financial support or the cultural importance of giving socially acceptable answers or "saving face." Van Gog, in her ethnographic study of the Sierra Leone Psychiatric Hospital, describes a typical meeting between international NGO workers and local government representatives. She observes: "*While in Sierra Leone culture, keeping up appearances is considered a virtue and problems are solved behind the scene, the Western NGO workers in the audience were eager to openly discuss the problems in the field of mental health care in order to work towards solutions there and then*." (44, p. 68) The meeting ended in an impasse (44).

Puddy and Hall identify the arrows connecting the three systems in the ISF as "knowledge brokers," which work between and across systems, have a crucial understanding of the context (sociopolitical/mental health/cultural climate, policies, funding, and research), and facilitate a flow of pertinent information between the systems. They serve the needs of the knowledge producers as well as the end users (107). An institutionalized brokerage approach was used in East Africa in an effort to close the gap between health research and policy (108). While a formal approach to knowledge brokering may be a step too far for CAMH in Sierra Leone, the author thinks that the Mental Health Coalition of Sierra Leone may be able to play an important role in facilitating knowledge brokering across the systems, as one of the Coalition's goals already is to act as an advisory body on issues of mental health in Sierra Leone (45).

LIMITATIONS AND STRENGTHS

A critical analysis of a country's mental health system by one person has obvious limitations. The strength of being a long-term participant and observer in mental health can become a limitation when the author develops personal biases or blind spots that hinder an objective perspective. In addition, after the EVD outbreak, the author spent 2 years out of the country, after which she returned to work in a remote rural area in Sierra Leone. There, she experienced first hand the reality of being relatively isolated from many deliberations and activities related to national mental health care development, which is a potential source of bias. While these are important limitations, the author spent most of her years working with community-based organizations and speaks the lingua franca of the country, which has hopefully increased her contextual and cultural awareness. To minimize the limitations of a one-person approach, the author has had frequent discussions with local and international colleagues in the field of mental health, and extensively consulted with gray and international literature to verify and test her observations. To increase validity, the article was also reviewed by two Sierra Leonean mental health experts, including a physician trained in CAMH.

CONCLUSIONS AND RECOMMENDATIONS

In this paper, I have used the ISF to analyze CAMH service development in Sierra Leone. In this last section, I will evaluate the usefulness of the ISF in this type of exercise and highlight some of the issues that were identified to strengthen the dissemination and implementation of CAMH interventions in Sierra Leone.

Based on the analysis in this paper, I propose that the ISF can be a useful framework to analyze and guide the dissemination and implementation of CAMH interventions in lower- and middle-income countries. It shows the need for comprehensive policy making, planning, and funding, taking into account the various activities that bridge the gap between science and practice. The ISF could be even more useful if the role of community-based practitioners were to be acknowledged in the delivery system. In an altogether different context, Firesheets and colleagues' main criticism of the ISF is that the role of the community in the delivery system "*is implied but not clearly defined*" (109, p. 354). In line with their suggestion, I propose to divide the Delivery System into Community-Based Practitioners (traditional and religious healers) and Professional Practitioners, each representing their own general and specific capacity (see **Figure 2**). An added benefit of the visualization of the Community-Based Practitioners in the framework is that it may encourage an increase in community-centered approaches (110) in addition to the more commonly used top–down or research-driven approach for the development of interventions. Effective elements in the services provided by Community-Based Practitioners could be identified and developed into contextually relevant interventions that supplement the efforts of Professional Practitioners. Both groups of practitioners could learn to appreciate each other's contribution to the Delivery System and collaborate and refer for the benefit of children and adolescents with mental health problems. Whether the two groups need to be supported separately by parallel support systems remains something to be discussed.

In addition, considering the importance of the cultural context in which CAMH is developed, I suggest, similar to Gregory and colleagues (20), an increased emphasis on cultural competence in the ISF, both on the three System levels and in knowledge brokering. A modification of the model in this respect does not seem necessary as long as culture is included as an important aspect of the surrounding context.

While the ISF is a useful structure to optimize dissemination and implementation, as Lesesne and colleagues note, it does not offer solutions for the challenges that can arise from the context, such as funding or policies (15). Lack of funding and the absence of suitable policies continue to be major hindrances to the development of CAMH services in Sierra Leone. This leaves a challenge for the government and international donors. With the high percentage of children and adolescents in the population of Sierra Leone, it is surprising that so little attention is given to child and adolescent mental health. Quoting Bronfenbrenner, Betancourt and Kahn point out that the position and priority that children and those who work with them have in macrosystems determines how they are treated across ecological settings. (103) It seems that the lower status that children hold in Sierra Leone society has led to a neglect of their mental health needs on multiple

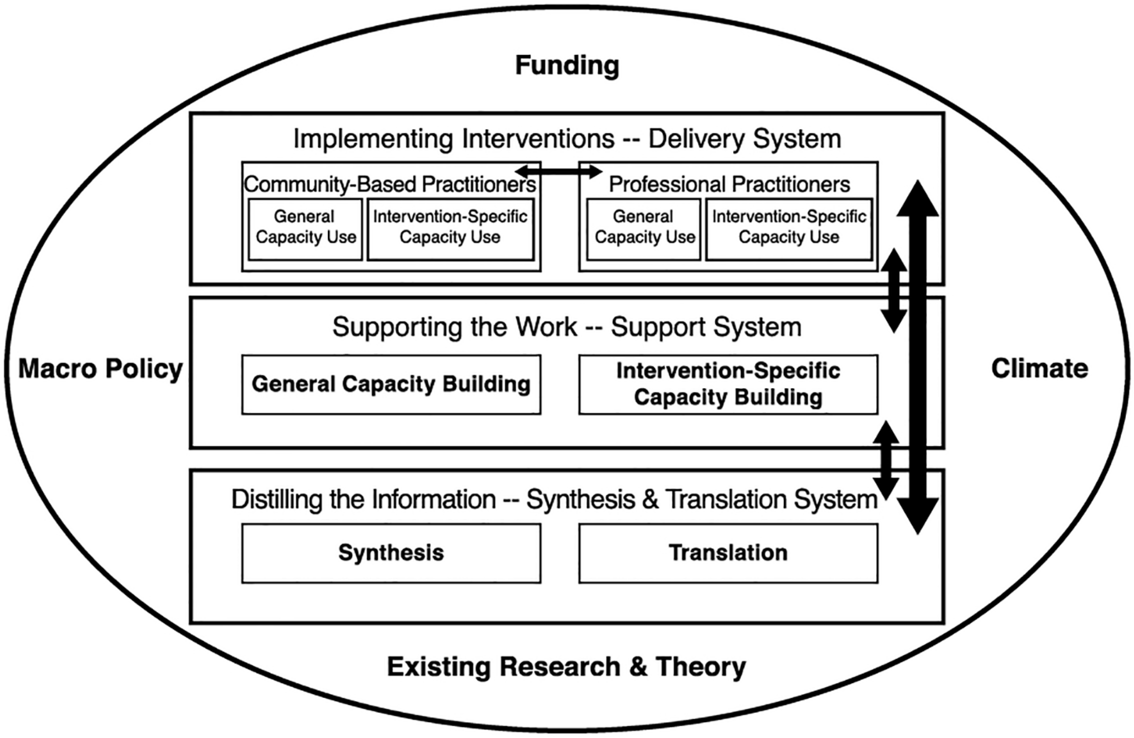

FIGURE 2 | The Interactive Systems Framework (14) with Inclusion of Community-Based Practitioners.

levels. Advocacy by, with, and on behalf of children and adolescents is needed to give a voice to this significant part of the population. Although policy reform does not always translate into implementation (45), I agree with Belfer that the development of a specific CAMH policy is essential for the development of a nation's CAMH system (111). In addition to funding and policies, CAMH care development in Sierra Leone could benefit from the development of contextually relevant CAMH interventions, improvement of innovation-specific and general capacity building, and acknowledgement of the role of Community-Based Practitioners in the delivery of CAMH services. Local mental health experts, especially those trained in CAMH, should be empowered to work together with culturally competent expatriate professionals on all three system levels of the ISF to improve CAMH care in Sierra Leone.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

FUNDING

The Open Access publication fees for this article were funded by the Amsterdam Institute for Social Science Research, University of Amsterdam.

ACKNOWLEDGMENTS

The author wants to acknowledge the invaluable input and suggestions by Prof. Dr. Ria Reis, Prof. Dr. Joop de Jong, Dr. Wietse Tol, Dr. Sarah K. Conteh, and Joshua A. Duncan.

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Conflict of Interest: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers
in Psychiatry

BRIEF RESEARCH REPORT
published: 11 November 2019
doi: 10.3389/fpsyt.2019.00769

Development of the WHO Caregiver Skills Training Program for Developmental Disorders or Delays

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Globally, 52.9 million children under the age of 5 experience a developmental disability, such as sensory impairment, intellectual disability, and autism spectrum disorders. Of these 95% live in low-and-middle-income countries. Most of these children lack access to care. In light of the growing evidence that caregivers can learn skills to support their children's social communication and adaptive behavior and to reduce their challenging behavior, the World Health Organization developed a novel Caregiver Skills Training Program (CST) for families of children with developmental disorders or delay to address such treatment gap. This report outlines the development process, content, and global field-testing strategy of the WHO CST program. The CST program is designed to be feasible, scalable, and adaptable and appropriate for implementation in low-resource settings by nonspecialists. The program was informed by an evidence review utilizing a common elements approach and was developed through extensive stakeholder consultation and an iterative revision process. The program is intended for a global audience and was designed to be adapted to the cultural, socioeconomic, geographic, and resource context in which it is used to ensure that it is comprehensible, acceptable, feasible, and relevant to target users. It is currently undergoing field-testing in more than 30 countries across all world regions.

Keywords: neurodevelopmental disorder, developmental delay, disability, caregiver skills training, parent-mediated, nurturing care

OPEN ACCESS

Edited by:
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Specialty section:
This article was submitted to
Child and Adolescent Psychiatry,
a section of the journal
Frontiers in Psychiatry

Received: *31 May 2019*
Accepted: *24 September 2019*
Published: *11 November 2019*

Citation:
Salomone E, Pacione L, Shire S, Brown FL, Reichow B and Servili C (2019) Development of the WHO Caregiver Skills Training Program for Developmental Disorders or Delays. Front. Psychiatry 10:769. doi: 10.3389/fpsyt.2019.00769

INTRODUCTION

Around 250 million children, or 43% of all children younger than 5 years, in low- and middle-income countries (LMICs) are at higher risk of not reaching their developmental potential due to stunting, poverty, and disadvantage (1). In 2016, it was estimated that globally 52.9 million children younger than 5 years experienced a developmental disability, such as sensory impairment, intellectual disability, and autism spectrum disorders, and 95% of them lived LMICs (2). Most of these children lack access to care. Convincing evidence shows that parents are able to learn skills to effectively promote their children's development and positive behavior (3).

The WHO is seeking to address this treatment gap and strengthen access and quality of health services and supports to families (4). In this context, a novel program to strengthen caregiving skills for families of children with developmental delays and disorders was developed. The program stems from the need to provide nurturing care to all children, a principle called for by both the WHO Global Strategy for Women's, Children's and Adolescents' Health and the United Nations Sustainable Development Goals on access to high-quality early childhood development. As such, the program is based on the assumption that caregivers of children with developmental disorders or delays can and should be specifically supported in both tapping into their existing competences and developing new skills that can foster their child's learning, social communication, and adaptive behavior. This report outlines the development process and content of this novel caregiver-mediated intervention for neurodevelopmental disorders and delays, followed by considerations for necessary cultural and contextual adaptations, and the need for future evaluations of efficacy and cost-effectiveness.

DEVELOPMENT OF THE WHO CAREGIVER SKILLS TRAINING PROGRAM

Central to the development of caregiver skills training (CST) was the requirement that the target beneficiaries of the intervention were children with heterogeneous developmental difficulties and there was a need to promote scale-up in LMICs with the use of briefly trained nonspecialists. The program was designed to adopt a family-centered approach that fit within a stepped-care model, where CST is to be integrated into existing maternal, child, and family health and social services. In terms of the estimated economic impact of implementing the program, it is notable to mention that the requirements for training the intervention providers, who are nonspecialists, are much lower than in many other comparable fee-based intervention programs requiring specialist providers; thus, the implementation costs are expected to be lower. The impetus for the development of the CST program lies within the WHO's mhGAP Intervention Guide for mental, neurological, and substance use disorders in nonspecialized health settings, which since 2010 recommends parent skills training for developmental disorders or delays, if available (5). However, at the time this recommendation was made, no such program was freely available to use, adapt, and scale up globally. This, along with increasing global interest reflected in the World Health Assembly's resolutions on mental health in general and the one on comprehensive and coordinated efforts for the management of autism spectrum disorders specifically (6), created the momentum for WHO to develop the CST for a global audience. Among the key priority areas of action for WHO and partners, the development and facilitation of access to competency-based training materials for a range of care providers including parents were established in a subsequent WHO technical consultation.

The formative process to develop CST consisted of a systematic review and meta-analysis and an extensive expert consultation. The systematic review included the analysis of implementation processes and component analysis using metaregression techniques with the aim of identifying key components and characteristics of efficacious interventions (7, 8). The review findings indicated that caregiver-mediated interventions for families of children with autism spectrum disorder who are early communicators and of children with intellectual disabilities can be effectively delivered by nonspecialists in community settings and that improvements in both child developmental and behavioral outcomes and family well-being could be achieved even with low-intensity programs. It also showed that programs that included behavior management techniques and strategies to improve caregiver coping were more effective than programs that did not contain this content. Additionally, programs that used a combined delivery format of group and individual sessions showed a greater impact than either format used in isolation on reduction of challenging behaviors.

As starting point for the development of CST, the results of the systematic review and meta-analysis were examined and discussed by global leaders with experience in parent-mediated interventions from diverse professional, geographic, and cultural backgrounds at a meeting at WHO Headquarters. The meeting included representatives from 21 countries across all six populated continents with a majority of representatives from LMICs, according to World Bank Classification. Representatives included academic leaders, clinicians, foundation leadership, practitioners, and caregivers (beneficiaries). These representatives were asked to advise on content and structure of the intervention, help address acceptability and feasibility concerns, and identify capacity building strategies.

A few aspects of the program were carefully considered at the intervention design stage: (a) engagement of other caregivers and family members; (b) promotion of caregivers' well-being and acceptance of the child's difficulty as prerequisites to learning skills; (c) potential demand-side barriers to accessing the program, including stigma; and (d) heterogeneity of children's developmental and health profiles, with particular regard to the high prevalence

A modular approach was suggested with "core" individual and group sessions followed by additional optional sessions, to address specific needs and considering availability of resources. The content of the core sessions was recommended to include promoting joint engagement, promoting spoken and nonverbal communication to request and share attention, reducing challenging behavior, teaching skills for daily living, and promoting caregiving well-being. Additional topics that were suggested as important included strategies tailored for children who have minimal spontaneous spoken language and additional materials on caregiver well-being and comorbid conditions. Alternative scripts for stories and role plays are provided to enable further tailoring of the content to the needs and priorities of families.

The program was designed to include a combination of group sessions in community centers, health centers or schools and individual sessions in caregivers' homes. The group format for most of the intervention keeps implementation costs (human resources, travel time) to a minimum and promotes peer support among caregivers, while the individual home visits allow the intervention to be responsive to each family's needs by tailoring guidance to the caregiver and child characteristics. The home visits serve in fact the purpose of setting goals for the child's development based on the assessment of skills in a naturalistic setting and the identification of family priorities; tailored coaching on the intervention strategies is then provided, and goals are periodically reassessed. Home visits are also critical for rapport building with the whole family and identification of additional family needs requiring referral to other services or professionals.

A cascade training and supervision model was decided on as a critical element for effective and cost-effective implementation of CST by nonspecialist providers (such as nurses, community health workers, and peer caregivers) at the health facility or community level, or in schools, allowing for program scale-up. To effectively support the implementation of CST by nonspecialist providers, especially in lower-resource settings, a continuous support and supervision model was incorporated.

Given the global lack of service providers and long wait times, which would create an unnecessary delay in access to needed treatment, the inclusion and exclusion criteria for the target beneficiaries of the intervention were chosen to be as inclusive as possible, and it was decided that a diagnosis should not be required. The target group for the program was therefore identified as that of caregivers of children aged 2 to 9 years presenting with a developmental disorder or delay. A further consideration was that creating a program exclusively for families of children with a formal diagnosis of developmental disorder could be a barrier to families' engagement due to lack of diagnostic services, delay in diagnosis, and stigma. The wide age range was decided on because children are often identified late, particularly in low-resource settings, and a program for caregivers of younger children would need to be offered in partnership with early intervention programs, which may not be yet in place. Other principles agreed on included the need to carefully consider the optimal intensity of the program in terms of number and duration of sessions. Considerable attention was paid to retention strategies designed to decrease the risk of dropout and increase engagement of families, such as regular phone calls, text messages, and provision of refreshments.

CONTENTS AND STRUCTURE OF WHO CST

With regard to the selection of intervention goals, the program was designed to target (a) the child's development, specifically in regard to promoting social communication and adaptive skills and reducing disruptive and challenging behavior; (b) the caregiver–child relationship; (c) the child's participation and inclusion in daily home and community activities; and (d) the caregiver's role and functioning, by promoting self-confidence, parenting skills and knowledge, and coping skills and psychological well-being. The program was designed to include nine core modules for group sessions aimed at training caregivers in the use of strategies that target key domains of child and caregiver functioning (**Table 1**), complemented by three home visits; three optional group session modules were also developed. Home visits are scheduled before the first group session, before the midpoint of the program and after the last group session, with the purpose of tailoring the intervention to the families' individual environments, goals, and needs.

A major recommendation from the expert consultation was the requirement to appropriately address the heterogeneous needs of children and families, given the broad target group. To allow the intervention to be tailored to children and families' needs, a threefold strategy was devised: first, goal-setting activities were embedded throughout the program to ensure that the intervention could be tailored to the child's developmental level and the family's priorities and flexibly adjusted as the child progresses. To this end, during the first home visit, the nonspecialist provider works jointly with each family to identify two "target routines" (semistructured opportunities for learning and development, as explained below) that match the interventionist's observations about the child's needs and developmental level, while meeting the family's priorities and daily activities. These target routines are regularly revised during the program to ensure that they continue to be appropriate. The second individualized component of the program consists of one-to-one coaching provided to caregivers both during group sessions, through role-play activities, and at the home visits, during live interaction with the child. The coaching component facilitates learning of the intervention strategies taught during the group sessions, ensuring that the caregiver is given clinically sensitive, individualized feedback to develop those skills and competencies that particularly suit the child's needs. Lastly, optional modules with a focus on (a) children who have minimal spontaneous spoken language, (b) those with other comorbid conditions, and (c) caregiver well-being were made available to ensure that comorbidities and other co-occurring needs could be addressed.

A suite of materials for field testing was developed, including (a) intervention manuals and user-facing documents (session-by-session facilitator guides, facilitator home visits guide and goal setting form and session-by-session participant booklets); (b) materials developed to assist countries in the planning and adaptation phases (planning guidance, planning meeting materials, adaptation and implementation guidance

TABLE 1 | WHO caregiver skills training: structure.

Module	No. of sessions	Notes
Engagement	2	Dedicated module. Sessions can be delivered separately or as a single session
Play and home routines	1	Dedicated module
Communication	2	Dedicated module
Behavior management	2	Dedicated module
Adaptive behavior	1	Dedicated module.
Caregiver self-care and ongoing practice	1	Dedicated module. Self-care activities are also embedded in each of the other core sessions.
Minimally verbal children	3	Optional module
Comorbid conditions	1	Optional module. Informative text is also embedded in each of the core sessions.
Caregiver well-being	3	Optional module

and materials); (c) materials for training master trainers and facilitators (training of trainer [ToT] course and supervision models); and (d) materials to record, monitor, and assess processes and outcomes in the prepilot and pilot-testing phases (monitoring and evaluation framework).

Theoretical framework and methodology

The program's theoretical foundation and methodology are informed by principles of applied behavior analysis, developmental science, social communication interventions, positive parenting, and self-care methods. The primary program targets are defined as increased spontaneous nonverbal and verbal communication and increased time in shared engagement, and secondary targets include reduced child challenging behavior, improved caregiver coping skills and psychological well-being, and improved family functioning. The program was developed with an additional aim of facilitating stigma reduction against persons with developmental disorders and promoting increased inclusion and community participation of these children.

The common thread to accomplish the program's goals is the shaping of common activities into regular shared caregiver and child routines that become opportunities for learning and development. Caregivers are encouraged to practice interacting with their child within both "home routines" (setup within activities done regularly, such as eating, dressing, caring for animals, tidying and going into the community to run errands, pick up siblings, or enjoying being outside) and "play routines" with toys and recycled materials (e.g., cups or cardboard boxes) that are easily available to the family. Over the course of the program, caregivers are taught intervention strategies derived from principles of Naturalistic Developmental Behavioral Interventions and principles of applied behavior analysis for neurodevelopmental disorders. Naturalistic Developmental Behavioral Interventions, which include JASPER (9, 10) and PRT (11), are intervention methods derived from principles of both behavioral learning and developmental science (12). At the core of the CST program is therefore, on the one hand, the developmental principle that children's development is favored within developmentally appropriate (13, 14), affectively rich (15) learning contexts. Within that framework, such contexts become learning opportunities where the adult follows the child's choices of materials and activities (16), promptly responds to and expands child's communication, and actively transforms activities into motivating play or daily living routines (17), with an emphasis on turn taking, affect, and developmental appropriateness of materials and tasks. On the other hand, CST uses incidental teaching techniques incorporating elements of the science of learning including modeling, shaping, chaining, prompting, and differential reinforcement within the context of natural stimulus conditions of everyday environments (18).

Such teaching techniques are used within a naturalistic framework, with the use of natural rewards (19), use of child-preferred options (20), and reinforcement of approximations and communicative attempts. Principles of functional analysis derived from applied behavior analysis are also taught within CST, and strategies to support the child's regulation are illustrated. Emphasis is given on the use of a variety of environmental strategies to support child's engagement, promote spontaneous communication, and reduce dysregulated or challenging behavior (9). In this respect, foundational strategies include guidance on the adult's positioning (in front of and at the child's level, with the activity in between them) and offering the child to choose among a range of developmentally appropriate materials. Other "environmental strategies" include strategically arranging the setting (by controlling access to materials of interest and using materials that either require assistance, are provided in small quantities at a time or are in sight but out of reach) and creating affectively salient contexts that require the child's active participation, such as playful obstruction, expectant waiting, or violating an established routine.

An additional desirable characteristic of this approach is that it facilitates caregivers' involvement because these naturalistic teaching strategies can be easily implemented within the family context, by transforming everyday activities (meals, bath time, outings, etc.) into child-led learning opportunities with a clear structure (routine building) that work toward prespecified developmentally appropriate targets (goal setting). Exposing the child to multiple learning experiences targeting the same skills in different real-life contexts (as opposed to structured trials with artificial stimuli) is shown to predict greater generalization of skills, tolerance of real-world distractions, and reduced dependence on prompting (21).

Furthermore, the approach favors and reinforces the parent's natural role, since caregivers are encouraged to commit to daily moments of interaction with the child within regular activities that would be carried out regardless, instead of being asked to take up the role of a "therapist" carrying out additional structured tasks, resulting in happier, less stressful interactions and more positive communication styles (22). Caregivers of children with developmental disabilities experience higher stress and distress than parents of typically developing children (23, 24). Furthermore, parent distress predicts child outcomes and outcomes from behavioral parenting interventions (23, 25, 26). Therefore, the approach emphasizes the importance of parent self-care throughout core sessions, including introduction of relaxation exercises. An optional module on caregiver well-being is also incorporated, which draws on strategies from acceptance and commitment therapy, an empirically based approach that has shown promise in improving parent and child outcomes in families of children with disabilities (27–30).

To provide a practical example of how within CST caregivers are taught routine building, we illustrate below how to establish a routine in the context of a caregiver and child dyad taking items out of a shopping bag. First, the adult would need to identify which specific actions constitute, on that occasion, the steps that are appropriate for them and their child to follow (e.g., for a child who can use word combinations and combine different materials and play actions, these may include labeling and sorting groceries into different containers or areas in a cupboard, while for an early learner, taking each item out of the bag while the adult provides simple language may be enough). Then, the adult would make sure to assume an active but balanced role, rather than solely asking the child to complete actions or, conversely, dominating the interaction completely by leading all the steps. A balanced active role would therefore entail taking turns with the child in completing each step; these may mean alternating on doing the same action (direct imitation), or steps may be different for the child and the adult, such as the child taking items out and the adult putting them into a cupboard or container. A strong focus would be given on promoting child engagement by making the routine affectively salient (e.g., showing enthusiasm and pairing actions with display of affection or adding "fun elements," such a song). The underlying goal, in line with the programs' primary targets, would be to promote the child's communication by giving the child the opportunity to communicate (staying silent and looking expectantly at the child on the child's turn) and responding and expanding the child's communicative signals (gestures, sounds, words, or eye gaze) by combining a gesture and language at the child's level (e.g., to describe each item they remove from the bag or to label relevant actions, such as "out!"). Positive attention, imitation, and social rewards (praise) would be provided contingently to the child's actions or approximations, in order to reinforce the performance.

The evidence-based principles illustrated above are taught to caregivers using accessible language as *key messages* (general psychoeducational messages about developmental disorders and delays) and *tips* (hands-on strategies and skills for interacting with the child). The latter are shown during the group sessions through adult-learning techniques such as group discussions, modeling, and guided role playing (**Table 2**). Illustrated booklets with the key messages and tips are provided to participants at each group session. In addition, the one-to-one provider-to-caregiver coaching provided during the home visits (prior to the first group session, midway, and at the end of the program) is an opportunity to give more emphasis on strategies that are most relevant and suitable for each caregiver–child dyad.

Fidelity of Implementation Criteria

In line with most evidence-based interventions, the CST intervention package includes measures of fidelity of implementation. As delivering CST involves both proficiency in leading group sessions and mastering the direct use of intervention strategies with children, competencies in these domains are assessed, respectively, with an adaptation of the ENACT (ENhancing Assessment of Common Therapeutic) scale (40) and a bespoke Adult/Child Interaction Fidelity Scale (WHO CST Team, unpublished). The Adapted ENACT (WHO CST Team, unpublished) includes assessment of verbally illustrating and modeling use of strategies, facilitating group discussion, coaching caregivers within role play, and sensitive reflection and feedback provision. Ratings can be done on video recordings or live observations of group sessions and home visits representing at least 25% of the program content. The Adult/Child Interaction Fidelity Scale is rated on 15-minute video recordings of interaction within either home activities or play contexts and covers use of strategies to support regulated behavior and promote engagement and communication and child's learning of new skills. Since fidelity of implementation is key to optimal child outcomes (41–43), the WHO CST Team encourages the assessment of fidelity in all phases of field testing.

TABLE 2 | WHO caregiver skills training: activities and learning methodology.

Setting	Activity	Objectives	Methodology
Group session	Wellness activity	To promote and practice caregiver self-care	Diaphragmatic breathing relaxation exercises have been shown to reduce anxiety (31)
	Review of previous contents and home practice	Reflection on prior learning; self-reflection; problem solving: learners share personal experiences and knowledge with each other	Goal setting, self-reflection, and problem solving are evidence-based instructional strategies for adult learners (32)
	Discussion of a story	Learning through a caregiver's story followed by group discussion allows caregivers to see how skills and strategies can be implemented in day-to-day life. Caregivers in the stories model acceptance and normalize difficult emotional experiences common to caregivers	Integration of learning through story (33)
	Presentation of new content	Caregivers learn skills and strategies they can practice at home in small illustrated steps	Knowledge scaffolding: skills and strategies are broken down into small steps (34).
	Demonstration	Learners see how skills and strategies can be applied in routine activities with children	Demonstration followed by practice is an effective adult learning strategy (35)
	Role play	Rehearsal of skills and strategies with other learners in an ideal setting before practice at home	Structured role play (simulation) with feedback can improve skills and increase confidence (36)
	Plan for home practice	Goal setting for how knowledge and skills will be applied at home	Goal setting and self-reflection on personal goals are effective adult learning strategies, and home practice is a common element in caregiver-mediated interventions (37, 38)
Home visit	Review of home practice and goal setting	Learners set own goals for their child	Setting goals for the child is a common element in caregiver-mediated interventions (37)
	Coaching	Modeling of skills; reinforcing strengths; providing immediate feedback	*In vivo* coaching is used to refine skills and is a common element in caregiver-mediated interventions (37, 39)

CULTURAL AND CONTEXTUAL ADAPTATION OF WHO CST

As a global program, WHO CST was developed to be adapted to the cultural, socioeconomic, geographic, and resource context in which it is used. Adaptation refers to the systematic modification of an intervention to ensure that it is comprehensible, acceptable, feasible, and relevant to target users (44). There is evidence that culturally and contextually adapted programs are effective and improve feasibility (45–48). The implementation package for the CST program outlines the objectives and process of adaptation in detail using the Bernal Framework, a method for coding adaptation of interventions (49). This framework uses the ecological validity model, which consists of eight dimensions: language, persons, metaphors, content, concepts, goals, methods, and context (50). The goals of adaptation are to ensure that, first, the program content is comprehensible, culturally acceptable, and relevant to local participants; second, the program is responsive to the local socioeconomic, political, and cultural context, and third, it is delivered in a way that meets participants' needs. The adaptation process aims to maximize accessibility, feasibility, and acceptability and reduce foreseeable barriers to participation. As part of the development phase, effort was made to reduce the need for cultural adaptation by limiting the use of cultural symbols and phrases and utilizing more universal symbols and phrasing, using plain language whenever possible, avoiding Western biases such as toward individualism or consumerism, and aiming to ensure that the program is consistent with the reality of participants in low-resource settings. Illustrations in participants' booklets were designed to represent multiple cultures and socioeconomic contexts and to reflect the intended global audience. Adaptation guidance was created and included as part of the CST toolkit. The suggested process includes creation of a local adaptation team, formal consultation with an adaptation advisory group of community stakeholders, and adaptation framework, guidance, and documentation form. Adaptations to the program can be made to the program content (aspects of the nonspecialist provider guides and participants booklets) and to the program process (e.g., frequency and setting of group sessions, provision of additional services, supervision and training, etc.). Recommended adaptations to program materials include (i) translation into the local language, ensuring language use (vocabulary, phrasing, verbal style, etc.) is culturally appropriate, literacy level is consistent with that of the intended participants, and technical terms are explained in culturally and linguistically appropriate terms; (ii) changing aspects of content, including the names of characters in stories and role plays so that they are familiar to participants, adding local stories or examples; (iii) adaptations to improve feasibility and acceptability, including choosing an appropriate group session schedule (weekly/biweekly, daytime, or after hours), providing child care, refreshments, or culturally appropriate additional activities.

GLOBAL FIELD-TESTING INITIATIVE

An iterative process of revisions that incorporated inputs from the first stakeholder workshop and a second external expert review resulted in the finalization of program materials (WHO CST Test-Run Version). This version of the program was prepiloted for the first time with a group of caregivers of preschoolers with autism spectrum disorder and co-occurring intellectual disability in Northern Italy. The objective of the test run was the preliminary assessment of feasibility and acceptability of key delivery components and methods of the program prior to making available the materials for global field testing. Group sessions and home visits were led by a WHO CST Team member who contributed to the development of the program and translated the materials in Italian (ES), assisted by a local clinical psychologist with expertise in disability and parenting programs. The choice of specialist, rather than nonspecialist, providers was deemed necessary to allow for live troubleshooting, even though the program had been ultimately designed to be delivered by nonspecialists. The post-program qualitative–quantitative evaluations with caregivers and nonspecialist providers informed a light-touch revision of materials aimed at improving the provider's manuals by (1) streamlining redundant content, (2) editing the instructions for activities (e.g., demonstrations) that had been reported as lacking clarity, and (3) formatting the text to improve readability. The revised program materials were then made available for field testing in 2016 (WHO CST Field Test version 1.0). Data derived from the evaluation of feasibility and acceptability of the test run implementation and those collected from consultation meetings, master training courses, and prepilot testing of the WHO CST Original Version in the first countries involved in the global CST field-testing initiative, such as Ethiopia (51), were collated. The adaptation database that was created informed the development of a revision of the program materials for global field testing (WHO CST Field Test Version 2.0). This revised version comprises reduced and simplified contents organized in sessions of 2 to 2½ hours. The complete suite of materials for field testing includes intervention manuals, training and supervision models, monitoring and evaluation framework.

To date, there are 30 active field-testing sites, representing all WHO world regions, African (n = 4), Americas (n = 9), Eastern Mediterranean (n = 6), European (n = 4), Southeast Asia (n = 2), and Western Pacific (n = 5). Official field-test versions of the package are now also available in Spanish, and translations are in process in multiple other languages. Participating sites progress through four phases outlined in a monitoring and evaluation framework for field testing, consisting of (1) planning and adaption, (2) ToT and post-ToT practice, (3) prepilot field testing, and (4) pilot testing. Input from field testing is being collected in order to contribute to the development of the final version of the CST package, which will be made available on the WHO website.

A survey of adaptation processes and contents among sites participating in the field testing is underway. Preliminary data from 28 sites indicate that the majority of sites (n = 26) reported having adapted the program to the local context, mostly with minor measures: of these, 76% were adaptations of content (e.g., language use, idioms), 17% were adaptations to improve feasibility (e.g., child care), and 7% were adaptations of processes (e.g., frequency of group sessions). Minor changes to content included changes to names of characters, idioms, language use, aspects of stories, objects, style of character dialogues in the stories, the addition of psychoeducational messages particularly relevant to the context (e.g., addressing local myths about developmental disorders and delays), and modification of illustrations for ethnic, cultural, and contextual reasons. Changes to program process to support attendance included providing child care for group sessions, weekly peer support phone calls, refreshments, small gifts, post-program celebration, and additional outdoor self-care activities for caregivers. An adaptation for a low-resource, low-literacy setting was conducted in Ethiopia in consultation with community stakeholders. Adaptations included modification of activities that required writing, simplification of provider demonstrations and participant booklets, additional information on addressing expectations of a cure and discouraging physical punishment, removal of the picture schedule component, and increased emphasis on use of gestures. In pilot testing, the locally adapted WHO CST program was found to be acceptable and feasible for caregivers (51). The program was also adapted for delivery by family volunteers in rural Pakistan using a tablet-based application that serves as a training, intervention delivery, and monitoring tool. The key program contents (key messages and strategies) were incorporated into “real-life” narratives of the lives of three local children with developmental disorders, their family members, and other supporting characters with graphic images representing each character, which are used to voice narrative scripts (52). Adaptation and piloting of the program in high-income settings are also underway, including in Italy (53), Canada, and the United States.

The field-testing phase and, in particular, data derived from the planning and engagement workshops with stakeholders will provide additional insight into opportunities for integrating the support to caregivers into existing community-based services or programs. Additional studies, evaluating cost-effectiveness, component analysis, alternative delivery methods, and dosage, will also be beneficial. Findings from the field-testing and future research studies can be used to inform future implementation and research on scalable, sustainable interventions for children with developmental disorders or delays.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

Ethical review and approval was not required for the development of the caregiver skills training program described in this article, in accordance with the local legislation and institutional requirements. However, local ethics approval was obtained at field-testing sites in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CS conceived of and led the CST initiative. BR led the meta-analysis and systematic reviews, with support of CS, which helped establish the empirical evidence and theoretical framework of the CST program. LP, ES, SS, and FB contributed to the drafting of the CST program materials and field-testing materials; ES and LP supported field-testing sites with supervision by CS. AS provided institutional support. ES and LP led the writing of the paper with input from all authors.

ACKNOWLEDGMENTS

We are grateful to Autism Speaks for funding support and especially to Dr. Andy Shih for his tireless and remarkable efforts in advocacy and stakeholders’ engagement at country, regional, and global levels. We thank Dr. Lucia Murillo, Dr. Pamela Dixon, and Dr. Ya-Chih Chang, who contributed significant efforts in the training process. Finally, we wish to thank all of the consulting experts, reviewers, and local CST Teams for their work on the development and field testing of the program and the families who took part in the initiative.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers
in Psychiatry

SYSTEMATIC REVIEW
published: 13 November 2019
doi: 10.3389/fpsyt.2019.00806

Use of Technology to Promote Child Behavioral Health in the Context of Pediatric Care: A Scoping Review and Applications to Low- and Middle-Income Countries

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Specialty section:
This article was submitted to
Public Mental Health,
a section of the journal
Frontiers in Psychiatry

Received: *28 May 2019*
Accepted: *11 October 2019*
Published: *13 November 2019*

Citation:
Huang K-Y, Lee D, Nakigudde J, Cheng S, Gouley KK, Mann D, Schoenthaler A, Chokshi S, Kisakye EN, Tusiime C and Mendelsohn A (2019) Use of Technology to Promote Child Behavioral Health in the Context of Pediatric Care: A Scoping Review and Applications to Low- and Middle-Income Countries.
Front. Psychiatry 10:806.
doi: 10.3389/fpsyt.2019.00806

Background: The burden of mental, neurological, and substance (MNS) disorders is greater in low- and middle-income countries (LMICs). The rapid growth of digital health (i.e., eHealth) approaches offer new solutions for transforming pediatric mental health services and have the potential to address multiple resource and system barriers. However, little work has been done in applying eHealth to promote young children's mental health in LMICs. It is also not clear how eHealth has been and might be applied to translating existing evidence-based practices/strategies (EBPs) to enable broader access to child mental health interventions and services.

Methods: A scoping review was conducted to summarize current eHealth applications and evidence in child mental health. The review focuses on 1) providing an overview of existing eHealth applications, research methods, and effectiveness evidence in child mental health promotion (focused on children of 0–12 years of age) across diverse service contexts; and 2) drawing lessons learned from the existing research about eHealth design strategies and usability data in order to inform future eHealth design in LMICs.

Results: Thirty-two (32) articles fitting our inclusion criteria were reviewed. The child mental health eHealth studies were grouped into three areas: i) eHealth interventions targeting families that promote child and family wellbeing; ii) eHealth for improving school mental health services (e.g., promote school staff's knowledge and management skills); and iii) eHealth for improving behavioral health care in the pediatric care system (e.g., promote use of integrated patient-portal and electronic decision support systems). Most eHealth studies have reported positive impacts. Although most pediatric eHealth studies were conducted in high-income countries, many eHealth design strategies can be adapted and modified to fit LMIC contexts. Most user-engagement strategies identified from high-income countries are also relevant for populations in LMICs.

Conclusions: This review synthesizes patterns of eHealth use across a spectrum of individual/family and system level of eHealth interventions that can be applied to promote child mental health and strengthen mental health service systems. This review also summarizes critical lessons to guide future eHealth design and delivery models in LMICs. However, more research in testing combinations of eHealth strategies in LMICs is needed.

Keywords: mHealth, eHealth, pediatric, behavioral health, parenting, framework, health service, low-and-middle-income country

BACKGROUND

Pediatric Mental Health Needs and Service Challenges in LMICs

The burden of mental, neurological, and substance (MNS) disorders accounts for 10%–14% of the Global Burden of Disease (1, 2), and this burden is greater in low-and-middle-income countries (LMICs) because of high rates of poverty, violence, health problems, and inadequate health systems (3, 4). An estimated 171 million young children in LMICs are "off track" in behavioral- and social-emotional development, which places them on the path to MNS disorders (5). Early prevention and intervention strategies focusing on child mental and behavioral health promotion strategies can reduce this burden and its sequelae, but limited mental health prevention and treatment services are available for children and families in LMICs. Although the World Health Organization (WHO) recognizes MNS disorders as a global priority, and MNS disorders are now discussed at the highest-level policy forums devoted to global health and development, solutions for reducing burden remain limited.

Population health is largely influenced by social determinants (6, 7). High child mental health burden in LMICs may stem from inequalities in social status, resource allocation and opportunities, medical and social service access, and the quality of living environments (7–9). Many children in LMICs are living in families with low financial capital and high levels of family stress (e.g., violence, poverty-related stressors, maltreatment) and in communities with poor mental health service, system, and resource. Adversities and stressors experienced by families can undermine positive parenting and child behavioral regulation, which are associated with higher mental health problems in young children in LMICs (10, 11). From a services perspective, children and parents from LMICs are far less likely than families from high-income countries to have access to parenting information, preventive or promotive mental health services, or participate in evidence-based early interventions because of the lack of child mental health resources and systems networks. Therefore, to effectively address children's behavioral and mental health needs, and minimize disparities in LMICs, solutions that focus on a wide range of individual, family, systems, and service determinants - as well as prioritizing early prevention and intervention - are needed (12–14).

Rapid Growth of eHealth Offers New Solutions to Address Barriers At Multiple Levels

The rapid growth and widespread of technology has the potential to address child mental health burden in LMICs by offering new solutions for improving health information and supports, service access, and resource challenges. Emerging studies from both high- and LMICs have provided supporting evidence of the potential to transform health services and systems using eHealth (15, 16). eHealth is defined as the use of information and communication technology (ICT), such as computers, mobile phones, communications satellite, patient monitors, and other technology tools for all aspects of health information, services, and integrated systems. mHealth (or mobile-health), a subcomponent of eHealth, is defined as the use of mobile devices (e.g., mobile phones, portable/mobile patient monitoring devices, personal digital assessment devices, and other wireless devices) for individual medical and public health practice (17). eHealth can be tailored to individual needs, provided at low-cost, used to improve distance communication barriers, support training and management, and is a sustainable implementation model (15, 18). eHealth has been recommended by the WHO as a health service-strengthening strategy, and shown to be effective in promoting individual patient health, enhancing family engagement, health knowledge, service access, team communication, and emergency support globally (19).

At the global country-level, since 2005, WHO has initiated the Global Observatory for eHealth (GOe), a joint group effort to support WHO member countries (including LMICs) to adopt digital technologies to improve public health as well as individual health and well-being (20). Much progress has been made in policies and legislation since the establishment of GOe. As indicated in the 2016 report, 87% of WHO member states had one or more national initiatives on mHealth, 58% of countries had applied eHealth strategies, and almost all of those (56%) had initiated eHealth for monitoring and surveillance of maternal, neonatal, and pediatric health (17, 21–23).

At the eHealth programming and intervention level, two recent eHealth scoping reviews also summarize progress of eHealth applications in child health promotion and in LMIC contexts. In the eHealth applications for child health, Barros and Greffin's (24) review (24) of 119 technology-based, parent-focused interventions found that different formats of web-based applications have targeted parents and aimed at health-related promotion, *via* both prevention and treatment support (e.g., universal preventions and interventions focused on adaptation to and management of chronic/severe acute health conditions). Most of these e-parent interventions were adapted from evidence-based interventions (EBIs), focused on child physical health (i.e., obesity, healthy eating, vaccination, child safety, alcohol/substance use, health service use, oral health, sexual, and reproductive health), and based on studies from high-income countries. The pediatric eHealth Strategies used were also focused on promoting parental self-management, specific parenting skills, or parent support (e.g., social support, providing customized feedback) (24). In the eHealth applications in the LMIC contexts, Bervell and Al-Samarraie (25) reviewed 66 articles to understand patterns of eHealth use across a spectrum of disease and health conditions in Sub-Saharan African (SSA) countries. They found that eHealth has been applied in a range of diseases/health conditions in SSA, including tropical diseases, infectious diseases (malaria, HIV/AIDS), oral health, infant health-related conditions, maternal health-related conditions (antenatal/postnatal care, postpartum hemorrhage), noncommunicable diseases (cervical cancer, blood pressure), and mental health (depression care). In addition, most eHealth strategies were designed for the purposes of disease/condition control and prevention (e.g., reminders toward medical care/activity adherence), population health monitoring and case report, information provision for treatment/prevention (e.g., health information to patients or health workers), data acquisition and patient records management, diagnosis (telepathology, digital radiology tools), training/recruiting/retaining health professionals, or decision-making/referrals (25).

While many eHealth benefits have been reported in the literature to date, there are limitations as well. For example, eHealth has been shown to be more useful for addressing low-intensity, high-frequency behavioral difficulties than high-intensity behavioral difficulties (26). For users with low literacy (e.g., low digital/technology and/or low literacy/educational attainment) or systems with low eHealth technology capacity or resource availability, the limitations would be greater. Additional steps would be needed before applying eHealth in these contexts (27, 28). Furthermore, the benefits of eHealth may not be guaranteed because mixed results are often reported (29). Well-designed, high quality evaluations are needed to better understand the factors and service delivery approaches and contexts that that contribute to of eHealth-related benefits (30).

In sum, the literature thus far suggests that much progress has been made in the development and implementation of eHealth strategies in both child health promotion and in LMICs; however, applications of these strategies in early childhood behavioral and mental health in LMICs remain limited. Given the growth and spread of technology and access, especially given the explosion in digital device ownership and improvements of ICT systems in LMICs (45%–89% with mobile-cellular telephone, 45%–54% with smartphone, 7%–18% with internet access) (20, 23, 31, 32), and the potential of eHealth to address multiple resource and system management barriers, an effort to build on existing evidence and develop new strategies for child mental health promotion is needed.

The Study Aims

As the first step to inform the development of eHealth (including mHealth) interventions and services for child mental health promotion in LMIC contexts, it is critical to understand and summarize current research and knowledge, especially related to the technology solutions/strategies, core components, and evidence that contribute to effective child mental health promotion. Moreover, to effectively reduce population mental health burden, early prevention and intervention eHealth strategies in children need to be prioritized. Thus, the overall goal of this paper is to address these eHealth knowledge gaps by reviewing related eHealth literature and applications focused on young children. This scoping review focuses specifically on:

1. Providing an overview of existing eHealth applications, research methods, and evidence of effectiveness in child mental health promotion (focused on children of 0–12 years of age) in diverse service contexts.
2. Drawing lessons learned from the existing research about the design strategies to promote usage (or user-engagement in technology use) and evidence of usability, acceptability, and satisfaction (usage patterns, level of engagement, and satisfaction in usage) to inform design, delivery, and evaluation strategies of future eHealth interventions in LMIC contexts.

METHODS

Literature Review Methods

A scoping review, drawing upon a broad range of applications of technology in medicine, psychology, and pediatric-related literature, was conducted. The scoping review method was applied because it provides a useful initial approach to generate foundational knowledge, and to inform approaches for a future systematic review (33). Therefore, this paper was not intended to be an exhaustive review of the literature, but rather to provide a high-level view of the approaches to the use and evaluation of eHealth strategies for child mental health promotion and prevention. In our scoping review, the five-step method outlined by Arksey and O'Malley (33) was applied. The five steps include: (1) identifying the research question; (2) identifying relevant studies/literature; (3) selecting studies; (4) charting the data; and (5) collating, summarizing, and reporting results.

A comprehensive literature search using the PubMed and PsycInfo databases was undertaken. Literature search terms used in this review are detailed in Box 1 in the **Appendix Supplemental File**. Included papers were critically appraised using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses—Extension for Scoping Review (PRIMSMA-ScR) guideline (34). The overall inclusion criteria of articles for this review included studies that: (1) examined eHealth applications in pediatric behavioral and mental health promotion or intervention; (2) reported either intermediate impacts (e.g., on providers) or direct impacts on child well-being; (3) examined eHealth strategies used in diverse service contexts (i.e., primary care, school, and community contexts); (4) were focused on young children (birth to 12 years; not adolescents); (5) were peer reviewed, published in English, in PubMed or PsycInfo from 2010 to 2018; (6) were not using telehealth or messaging/texting; and (7) were not focused on behavioral health related to childhood obesity and substance/alcohol use. We did not include telehealth in the review because most families in LMICs do not have access to digital tools for videoconferencing, which has been reported to be a more effective child telemental health approach (35). We did not include messaging/texting in the review because evidence suggests effective public health approaches to child mental health intervention require consideration of multicomponent interventions (e.g., including multiple domains of mental health knowledge, skill training, and practice support in parenting/child/health-worker interventions) (36–38). However, existing messaging/texting strategies tend to be used as support or enhancement strategies for interventions, and might be limited in serving as stand-alone mental health intervention strategies in multicomponent interventions (39–41). Finally, many adults and parents in LMICs have low literacy (primary or less than primary school education) and do not have smartphones, which make a messaging approach challenging. **Figure 1** shows the flowchart diagram of the selection of articles. Because this review relied on publicly available documents and, therefore, was exempt from Institutional Review Board determination.

RESULTS

One-hundred-and-forty peer reviewed articles from PubMed and 40 from PsycInfo were identified. Two duplicated articles were excluded. After reviewing for appropriateness, 32 articles (from 30 eHealth studies) were included for final review. Of these, 2 were scoping reviews, 4 were protocol papers (all using a randomized controlled trial design), and 26 were empirical articles that used a range of designs (i.e., experimental, pre-post comparison, cross-sectional, qualitative, or mixed method designs), and in different phases of eHealth design and testing (e.g., early user-design, feasibility, or efficacy testing phases). **Table 1S** in the Supplemental file documents the charting of review data in detail for the included studies.

Across the articles reviewed, three broad categories of literature about eHealth in child mental health emerged. We synthesized knowledge and lessons learned separately for these three areas: i) eHealth interventions targeting family members; ii) eHealth for improving school mental health services; and iii) eHealth for improving behavioral health service in primary care settings. About half of the eHealth studies (16/30) were conducted in the US, only one study was conducted in LMIC (Brazil), and the remaining studies were conducted in developed countries (13/30, such as Australia (5/30), UK, New Zealand, Netherlands). Regarding the content of eHealth interventions, about half of the eHealth studies (17/30) were adapted from evidence-based interventions (EBIs). The majority of the studies (23/30) reported impacts of the intervention using an experimental design (14/30), and almost all of these studies reported significant positive impacts (21/23).

Figure 2 provides a pictorial view that summarizes strategies and ways that eHealth has been applied in these three areas.

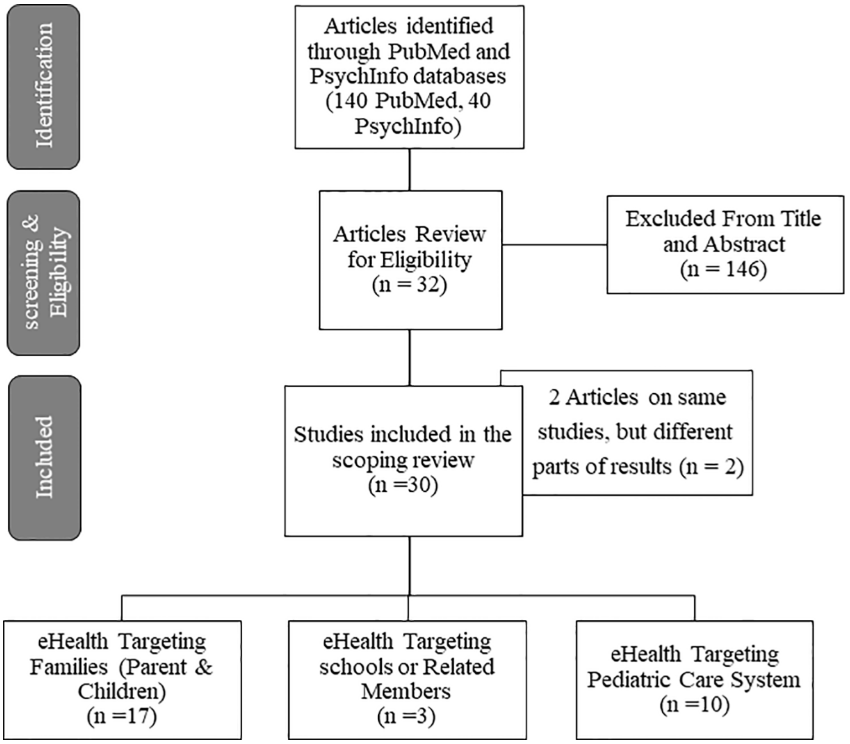
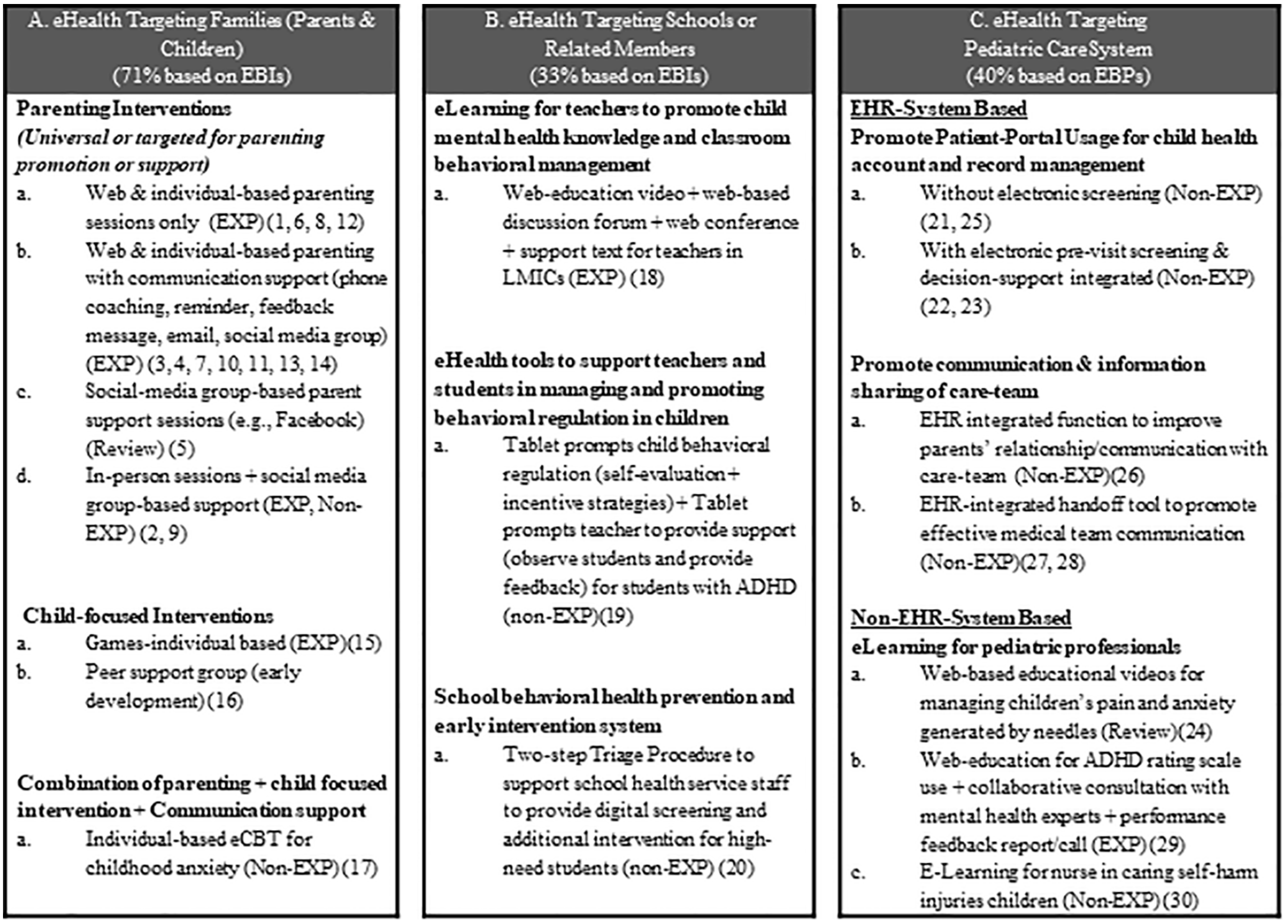


FIGURE 1 | Flowchart of the Selection of Articles.



A. eHealth Targeting Families (Parents & Children) (71% based on EBIs)

Parenting Interventions
(Universal or targeted for parenting promotion or support)
- a. Web & individual-based parenting sessions only (EXP) (1, 6, 8, 12)
- b. Web & individual-based parenting with communication support (phone coaching, reminder, feedback message, email, social media group) (EXP) (3, 4, 7, 10, 11, 13, 14)
- c. Social-media group-based parent support sessions (e.g., Facebook) (Review) (5)
- d. In-person sessions + social media group-based support (EXP, Non-EXP) (2, 9)

Child-focused Interventions
- a. Games-individual based (EXP)(15)
- b. Peer support group (early development) (16)

Combination of parenting + child focused intervention + Communication support
- a. Individual-based eCBT for childhood anxiety (Non-EXP) (17)

B. eHealth Targeting Schools or Related Members (33% based on EBIs)

eLearning for teachers to promote child mental health knowledge and classroom behavioral management
- a. Web-education video + web-based discussion forum + web conference + support text for teachers in LMICs (EXP) (18)

eHealth tools to support teachers and students in managing and promoting behavioral regulation in children
- a. Tablet prompts child behavioral regulation (self-evaluation + incentive strategies) + Tablet prompts teacher to provide support (observe students and provide feedback) for students with ADHD (non-EXP)(19)

School behavioral health prevention and early intervention system
- a. Two-step Triage Procedure to support school health service staff to provide digital screening and additional intervention for high-need students (non-EXP) (20)

C. eHealth Targeting Pediatric Care System (40% based on EBPs)

EHR-System Based

Promote Patient-Portal Usage for child health account and record management
- a. Without electronic screening (Non-EXP) (21, 25)
- b. With electronic pre-visit screening & decision-support integrated (Non-EXP) (22, 23)

Promote communication & information sharing of care-team
- a. EHR integrated function to improve parents' relationship/communication with care-team (Non-EXP)(26)
- b. EHR-integrated handoff tool to promote effective medical team communication (Non-EXP)(27, 28)

Non-EHR-System Based

eLearning for pediatric professionals
- a. Web-based educational videos for managing children's pain and anxiety generated by needles (Review)(24)
- b. Web-education for ADHD rating scale use + collaborative consultation with mental health experts + performance feedback report/call (EXP) (29)
- c. E-Learning for nurse in caring self-harm injuries children (Non-EXP) (30)

FIGURE 2 | Pediatric eHealth strategies for families, schools, and pediatric care. EXP, Experimental design; Non-EXP, non-experimental design; Numbers included (e.g., (20)) were corresponding study number (not reference number) listed in **Table 1** and **Table 1S**. EBIs, Evidence-based interventions; EBPs, Evidence-based practices/guidelines. Box A summarizes purpose and eHealth strategies applies that target families. Box B summarizes purpose and eHealth strategies applied that target schools. Box C summarizes purpose and strategies applied that target pediatric cares.

Table 1 presents key findings for the 30 eHealth studies that were reviewed (from 32 articles), cataloged by eHealth intervention, country, targets, methods, design strategies, and impact or feasibility evidence (derived from **Table 1S**, the charting of review data in Supplemental file). Below, we summarize findings for the three areas of child behavioral eHealth literature. In each area of eHealth literature, we highlight target users, purpose of the eHealth design and strategies applied, and efficacy/effectiveness evidence.

eHealth Targeting Families

Target Users

Most family-level eHealth interventions (for children 0–12 year olds) have targeted parent users (14 parenting-focused studies out of the total 17 family-focused eHealth studies), and fewer directly targeted child users (two child-focused out of 17 family-focused studies) or a combination of parent and child users (1 out of 17). Parents and children were from either community or at-risk samples (e.g., children with behavioral challenges; families with multiple adversity indicators or high stress).

Purpose and eHealth Strategies Applied (Figure 2A)

For parent-targeted eHealth interventions, most interventions were developed to improve parents' child mental health knowledge and behavioral management skills/practices through multisession/module and multicomponent interventions (purposes). These types of interventions were usually adapted from existing EBIs (71%). eHealth strategies applied include web-based parenting modules (included 4 to 12 interactive or structured parenting sessions), with (44, 45, 52–53, 54, 56, 57) or without (42, 47, 48, 50, 55) additional e-communication or e-support for parents (e.g., phone coaching, e-reminders, feedback messaging, email, social media groups). There were also some studies focused on parent support interventions (including information and emotion support) and wellness promotion (purpose) for families of children with challenging behavior. For these support/wellness interventions, social media, and group-based e-support strategies (e.g., Facebook, WhatsApp), with or without in-person sessions, were generally applied (43, 46, 52).

For child-targeted eHealth interventions, one study focused on promoting child social skills and mental health (for 7–11 years

TABLE 1 | Pediatric e-behavioral/mental health literature: study targets, methods, strategy, and impacts for the included articles.

mHealth study/ intervention	**Country**	**Targets**	**Methods**			**mHealth strategies**			**Impacts**
		Parent, child, provider	**EXP, non-EXP, review)**	**EBI/ EBP (Y)**	**Level of TX (I, G, S)**	**Parenting digital strategies**	**Child digital strategies**	**Provider/system digital strategies**	**Intervention effect**
Family-Level eHealth Strategies									
1.Web-Based Parent Management Training for children with conduct problems (42)	Sweden	Parents of 3–12 y/o	EXP (RCT)	Y	I	Web parenting training (7 sessions)			Positive (on P& C)
2. Brief home visit parenting intervention SafeCare + SafeCare-Facebook parenting group for parents at-risk for maltreatment (43)	US	Parents of 0–5y/o	Non-Exp (qualitative)	Y	I & G	3 weekly home visit sessions + 18 Facebook parenting network group			Positive (on P)
3. Stepping Stone web-based TX for promoting parenting knowledge and parent-child relationship (44)	Korean	Parents of 11–16 y/o	EXP (Quasi-Exp)		I	Web parenting training 4 weeks + weekly telephone coaching			Positive (on P)
4. Strongest Families Smart Website (45)	Finland	Parents of 4 y/o	EXP (RCT)	Y	I	Web parenting training sessions (11 sessions) + weekly phone coaching			Positive (on P & C)
5.Online Parent Social Support for parents of children with Special Health Care Needs (CSHCN) (46)	US	Parents of CSHCN	REVIEW (a scoping review)		G	Parent-to-parent support through digital media, particularly social media (Facebook) on emotional and informational support			Positive (on P, especially for aged 18–29 young adults)
6.ezPAREN, online parenting training program (47, 48)	US	Parents of 2–5 y/o	EXP (RCT - Protocol)	Y	I	Web/App-based self-administered parenting (6 modules)			Effectiveness not Yet Report, but adherence and user-engagement were high.
7.Triple P Online Community (TPOC), an online parenting program with social media and gaming features (49)	US	Parents of 2–12 y/o that are highly vulnerable	Non-EXP (pre-post)	Y	I & G	Web parenting (eigth sessions) + social media group support + reward system			Positive (on P)
8. (a)(b) Triple P- Positive Parenting Program- Online Brief- TPOL Brief) (50, 51)	Australia	Parents of 2–9 y/o with mild to moderate conduct problems	EXP (RCT)	Y	I	Web parenting training (5 modules) + Optional technology assisted communication tools (e.g., remainder, summary email)			Positive (on P & C)

(*Continued*)

TABLE 1 | Continued

mHealth Study/ intervention	Country	Targets	Methods			mHealth Strategies			Impacts
		Parent, child, provider	**EXP, non-EXP, review)**	**EBI/ EBP (Y)**	**Level of TX (I, G, S)**	**Parenting digital strategies**	**Child digital strategies**	**Provider/system digital strategies**	**Intervention effect**
9. Parent-Wellness WhatsApp Support Group to promote mothers' wellbeing of children with autism spectrum disorder (52)	Saudi Arabia	Parents of 26–78 month with Autism spectrum disorder	EXP (RCT)		I & G	4 WhatsApp-based parent psychoeducation & support sessions + 1-face-to-face session			Positive (on P)
10. Cool Little Kids Online Parenting training for prevent child anxiety (53)	US	Parents of 3–6 y/o who are at-risk for Anxiety	EXP (RCT)	Y	I	Web parenting training (8 modules) + Telephone consultation by psychologist when requested			Positive (on P & C)
11. COPING, a universal web-based parenting program to promote positive parenting (54)	US	Parents of 3–8 y/o	EXP (RCT - Protocol)	Y	I	Web parenting training (10 sessions) + automated feedback + online praised message + text message reminders			Not Yet Report
12. Universal internet-based ParentWorks parenting program (55)	Australia	Parents of 2–16 y/o	EXP (RCT - Protocol)	Y	I	Online-based parenting training (8 modules)			Not Yet Report
13. Telephone-Supported Triple P-Online Parenting Program TPOL (TPOLe) for parents with behavior challenge children (56)	Australia	Parents of 1–8 y/o with disadvantage or family difficulty	EXP (RCT)	Y	I	Web parenting training (TPOL) (8 sessions) + weekly telephone consultation sessions for 8 weeks			Positive (on P& C)
14.Parenting Resilient Kids (PRK), a web-based parenting program for child behavior problem prevention (57)	Australia	Parents of primary school-aged children	EXP (RCT- Protocol)		I	Web-based parenting assessment + web-tailored parent feedback report + personalized online modules (up to 12 interactive modules)			Not Yet Report
15. Adventures computer-based game to improve child social skills and mental health (58)	US	7–11 years old with social skills challenges	EXP (RCT)	Y	I		9 interactive online adventure games (include feedback, prompts based on performance)		Positive (on C)
16. Development of a Digital Peer Support Service (DPS) for children coping challenges (59)	US	8–12 year-old cancer survivor	Non-EXP (qualitative)		G		Personas-method (an user-center design method) was used to co-design DPS		DPS contents (3 primary personas for DPS)

(*Continued*)

TABLE 1 | Continued

mHealth Study/ intervention	Country	Targets	Methods			mHealth Strategies			Impacts
		Parent, child, provider	**EXP, non-EXP, review)**	**EBI/ EBP (Y)**	**Level of TX (I, G, S)**	**Parenting digital strategies**	**Child digital strategies**	**Provider/system digital strategies**	**Intervention effect**
17. BRAVE-ONLINE, web-based cognitive behavior therapy (CBT) for childhood anxiety (Primary focused on children, and secondary on parents) (60)	New Zealand	7–15 year-old children with mild to moderate anxiety after a nature disaster	Non-EXP (Pre-post follow-up)	Y	I	Web-based parenting modules (5 for parents of adolescents, and 6 for parent of younger children) + auto-reminder for missing a session + therapist support/weekly contact	Web-based child modules (10 20–45 min sessions) + therapist support/ contact		Positive (on P& C)
School-Level eHealth Strategies									
18.Web-based Learning Management System (WBIE) for training teachers on child mental health and management (61)	Brazil (LMIC)	Teachers of primary school students	EXP (RCT)		I & S			6 web-education videos (9 hr) + internet discussion forum + web conference + support text	Positive (on T)
19. iSelfControl, web-based application to support classroom behavioral management for students with ADHD (62)	US	Teachers and 9–11 years old children with ADHD	Non-EXP (13 days follow-up dyadic data)		I		Tablet prompts the child to self-evaluate and earn points for adaptive behaviors (every 30 min) + view progress & compare with teacher's rating	Tablet prompts the teacher evaluate child behaviors (record every 30 min) + view student rating & progress	Positive for some C (for those with high inside)
20. Two-step Triage Procedure for pediatric behavioral health preventive care in primary school (63)	Nether-lands	School health service (SHS) staff serving 4–8 years old students	Non-EXP (Cross-section feasibility study)	Y	I & S			A digital screening carried out by SHS assistants, and only children in need of follow-up were assessed by the SHS doctors or nurses	Positive (on School preventive service)
Pediatric Care/System eHealth Strategies									
21.Patient-Portal for Parents in pediatric care: feasibility & usage (64)	US	Parents of young children	Non-EXP (Cross-section feasibility study)	Y	I & S	Parent-portal for child health account, information, and record management		Patient-Portal integrated with EHR system	Positive (on primary care service & P)
22.Comprehensive electronic previsit screener: parent and provider experience and impacts (65)	US	Parents and Primary care physicians (PCPs) of 4–10 years old	Non-EXP (mixed method)	Y	I & S	Parent use of electronic previsit screeners for child behavioral health		Electronic Previsit screening system for parents and PCPs	Positive (on primary care service, P and PCPs)
23. PEDStestOnline, a web-based pediatric screening & clinical recommendation (www.pedstest.com/online) system (66)	US	PCPs and parents of 0–8 years-old	Non-EXP (existing data from 22 sites in 20 states)	Y	I & S	Parent-portal for child health screening (no screening results) and record management		Electronic screening + Parent-Portal with/ without integration with EHR system	Impact evidence not reported (Report only patterns of utilization and implementation)

(*Continued*)

TABLE 1 | Continued

mHealth Study/ intervention	**Country**	**Targets**	**Methods**		**mHealth Strategies**				**Impacts**
		Parent, child, provider	**EXP, non-EXP, review)**	**EBI/ EBP (Y)**	**Level of TX (I, G, S)**	**Parenting digital strategies**	**Child digital strategies**	**Provider/system digital strategies**	**Intervention effect**
24. Public available Educational Videos for managing children's pain and anxiety generated by needles (30)	Global	Parents and PCPs of infants and toddlers	REVIEW (a scoping review)		I	Web-based behavioral management strategy videos for parents or PCPs	child pain/anxiety management strategy videos	25 Public Educational Videos from YouTube & Google search	No impact evidence reported
25. eRedBook, a digitized version of EHRs in UK: Implementer and user experience and barriers (67)	UK	School health staff and parents of young children	Non-EXP (Qualitative study)	Y	I & S	Parent-portal for health management (enrolled by public health nurses and health visitors)		Enrolling parents to use EHR-Integrated Parent-Portal system	Negative (Many enrollment barriers; e.g., safety, complexity, literacy, WiFi availability)
26. An EHR-based tool with names, photos, and definitions of treatment team members to increase parents' accuracy in identifying care team (68)	US	Parents in pediatric care	Non-EXP (pre-post survey)		I & S	Parent use of integrated EHR functions to identify care team members & to build trust		An EHR function to improve parent-care team communication	Positive (on P)
27. eHand-over Tool, an EHR-integrated medical handover tool to improve medical handover between doctors (69)	Australia	Pediatric Providers	Non-EXP (cross-sectional survey)		S			An EHR-integrated tool to standardize and improve both the standard and efficiency/ efficacy	Positive (on pediatric care, Dr. satisfaction & workflow)
28.EHR-integrated strategies to increase discharge communication in multidisciplinary team & Impacts (70)	US	Pediatric PCPs & hospitals physicians	Non-EXP (Qualitative study)		S			4 strategies to improve communication: Standardize process; Make it Easy; Eliminate waste; & Incentivize	Positive (on Pediatric and Primary care service)
29. SHARE intervention, a multicomponent distance-learning/quality improvement program to improve PCPs' use of ADHD rating scale (71)	US	Pediatric care practices and PCPs	EXP (RCT)		S			SHARE includes: Web-based education; Collaboratively consultation with ADHD experts; and Performance feedback reports/calls	Positive (on PCPs and Primary care service)
30.Digital Education Program Development to Train nurse in caring for children with self-harm injuries (72)	US	Nurses in pediatric care	Non-EXP (a participatory approach)		S			e-Learning program for nurse that is sensitive to nurses' and care recipients' needs	No impact evidence reported (Report digital tool development process)
Total	**16 US; 1 LMIC; 13 Others**	**17 Family; 3 School; 10 Pediatric**	**14 EXP; 14 Non-EXP; 2 Reviews**	**17 Y**	**14 I; 2 G; 3 I+G; 4 S; 7 I+S**	**21 Parents (14 parenting training; 2 parent Support-Groups; 5 EHR-Portal)**	**5 Children (2 educational video; 1 game, 1 behavior regulation, 1 peer support)**	**15 System (3 school system; 10 pediatric system)**	**23 Impact Reported (21 positive; 2 Negative or uncertain)**

TX, *Intervention.* Level of TX; *I, individual family/child-focused; G, family/child group-focused; S, system-focused (school or pediatric care system).* EBI/EBP, *Evidence based intervention (defined as intervention adapted from EBI that used nondigital approach or digital-based EBI)/Evidence-based guideline (defined as evidence-based practice guideline recommended by professional pediatric society); Y, Yes.*
Exp, *Experimental evaluation (e.g., RCT, experimental comparison, quasi-experimental).* y/o, *years old.* Intervention Effect: *P, Parents; C, Child; T, Teacher; PCP, Primary care physicians;*

old) through use of online gaming sessions (including 9 game sessions, with feedback and prompts based on performance). The game components included game goals, rules, game mechanics, and procedures to generalize or transfer game learnings to daily life (58). Another study focused on the development of digital peer support tools by first focusing on content development, using a user-centered and participatory method to design personas (59). Yet other study targeted parent and child simultaneously; this multiuser and more intense treatment intervention focused on children with mild to moderate anxiety with an adaptation of cognitive-behavioral therapy (CBT) to a digital approach (with e-training modules and digital communication support) (60).

Efficacy/Effectiveness Evidence (Table 1 and Table 1S)

Among the reviewed parent-focused eHealth studies that had outcome data (11 studies), 7 were evaluated using experimental designs (70%). All 11 eHealth parent-focused interventions reported positive impacts on parenting, and six interventions also reported positive impacts on child mental health (based on short term or less than one-year follow-up period). Among the reviewed child-targeted eHealth studies that had child outcome data (2 studies), one used an experimental design, and all child studies (with 9–10 eHealth sessions) showed positive impacts on child mental health (58, 59).

eHealth Targeting School Mental Health Services

Target Users

Among the identified school-focused eHealth literature that promotes young children's mental health (3 studies), interventions targeted teachers (1/3 studies), school health personnel (1/3 studies), or students who had behavioral or mental health challenges (with teachers' involvement; 1/3).

Purpose and eHealth Strategies Applied (Figure 2B)

eHealth in school contexts has been applied to strengthen school mental health resources or improve school mental health care. For the eHealth that targeted teachers, the intervention was designed to train teachers on child mental health and classroom behavioral management (purpose). It used a web-based learning management system (WBIE) approach, including web-education videos (6 modules), online discussion forum, web conference and support text messaging, to support teachers' child mental health education and practices (61). This study was conducted in an LMIC (Brazil). For the eHealth that targeted school health personnel, the intervention was designed to entail a two-step triage approach to support school behavioral health services. In Netherlands, community-based school-health professionals (e.g., physicians, nurse, and health assistants) visit schools a few times a year for routine child health and behavioral health assessments. For students identified with problems or needs, additional services are provided. The eHealth two-step triage strategy was designed to provide preassessments (a digital screening questionnaire) to primary school students by trained school health assistants, as well as a built-in follow-up decision support function that allows the school health team to be notified to follow need-identified students (63). For the eHealth that targeted students with behavioral challenges, the intervention was design to improve ADHD students' self-regulation in classrooms by involving target students and their teachers in the behavioral observation-feedback loop (purpose). The eHealth strategy was to use a digital tool (iPad-based) to: (i) prompt students to self-evaluate their own adaptive behaviors (e.g., following instructions/rules, staying on task), (ii) earn rewards (points added or subtracted from their account); and (iii) view teacher feedback and compare self-ratings with teacher ratings of their behaviors (62).

Efficacy/Effectiveness Evidence (Table 1 and Table 1S)

Two of the school-focused eHealth interventions reported positive impacts on teachers or school health services (61, 63). Only the study conducted in the LMIC (for teacher education about child mental health and behavioral management) was evaluated using an experimental design (61). The ADHD digital-tool intervention only benefited students with high insight (62), indicating the importance of considering user characteristics in eHealth design and implementation.

eHealth Targeting Pediatric Care Settings

Target Users

Most eHealth in pediatric care focused on pediatric professionals, adults who care for children, or users of EHR systems (i.e., parents, pediatric care providers/PCPs, pediatric care team).

Purpose and eHealth Strategies Applied (Figure 2C)

For eHealth interventions that targeted pediatric professionals or adults who care for children, the interventions were usually designed for education purposes. For example, e-learning strategies and web-education models/videos might be applied to educate/train adults or professionals to screen or care for children with mental health related problems (e.g., ADHD, self-harm, anxiety) (30, 71, 72). The e-learning strategy might be combined with other e-collaborative/consultation or performance feedback communication functions (e.g., report or call) to provide additional support (70).

For eHealth interventions that targeted EHR users, two groups of studies were identified. One group of studies focused on promoting patient-portal usage to improve preventive mental health screening, record management for patients/parents (64, 67), and/or decision support for providers (e.g., integrate screening/decision notifications for providing additional services) (65, 66). For screening and patient record management, web-based or EHR-based previsit screening and e-account management strategies have been applied. These e-strategies were implemented through navigator assistance or self-serve account setup. For provider decision support, integrated screening/EHR strategies (e.g., with automatic scoring, alter-notification/prompt for action when at-risk case identified, and automated decisions that is built into the clinical workflow) have been applied.

The other group of EHR studies focused on promoting communication and information sharing among the pediatric care team. This could be either improving communication between patient and care team (68) or improving communications (standard, procedure, information format) among medical care team members (69, 70). eHealth strategies such as e-demonstration and integration of standardized activities/practice guidelines/forms/prompts with EHR processes have been applied.

Efficacy/Effectiveness Evidence (Table 1 and Table 1S)

Among the three reviewed e-learning studies (targeting pediatric professionals or adults who care for children), only one study evaluated the outcome using an RCT design (70). This study found that distance-learning that integrated web-based education, collaborative consultation, and performance feedback for PCPs on child mental health screening could increase PCPs' use of behavioral screening tools in pediatric care.

Among the EHR studies that focused on promoting patient-portal use, most showed positive evidence (2 of 3 studies), using a nonexperimental design. Parents showed improvement in use of EHR-portal or screening tools and positive pediatric care experience (64, 65). However, one study showed negative findings and challenges while implementing a patient-portal due to technology issues (e.g., web access issues, poor technology literacy in users) (67).

Among the EHR studies that focused on promoting communication and information sharing, all studies (three of three) reported positive impacts and user experience (e.g., increase use of e-communication tools/procedures, improvement in communication, care workflow) (68–70). However, none of these were evaluated using experimental designs or had reported impacts on child mental health outcomes.

eHealth Design Strategies for User Engagement and Usability

To draw lessons learned from the existing eHealth research on design strategies for engaging users in eHealth interventions (or design strategies that maximize products' usability, accessibility, and target users' needs) to inform future eHealth development in LMIC contexts, we synthesize findings from studies that discussed or provided evidence related to user engagement/user-centered strategies, usage patterns, level of engagement, and satisfaction of eHealth interventions. Twenty-one studies out of 32 studies that we reviewed provided these user engagement results and discussion; therefore, these articles were used for research synthesis.

Based on the available articles, we grouped user-engagement design strategies and usability evidence/lessons into four areas of eHealth applications. These include user-engagement strategies and usability lessons related to: i) e-parenting intervention design, ii) health worker eLearning/e-training design (i.e., eLearning strategies for pediatric providers, school health staff), iii) designing integrated e-screening and e-decision-support tools in primary care, and iv) designing workflow integrated e-communication/collaboration tools. We summarize findings in the sections below. **Tables 2A, B** also summarize key lessons from our analysis. User-engagement strategies marked with ** in **Table 2** were those that we believe are relevant to LMIC contexts.

User-Engagement Strategies and Usability in e-Parenting Intervention Design

In engaging parents to use e-parenting interventions (i.e., e-parenting in individual or group format), several strategies related to parent recruitment, technology literacy, privacy/safety, motivation to use e-parenting technology, and engagement in learning were identified as critical. For example, recruiting parents from traditional face-to-face practices would be a better recruitment strategy (e.g., with better retention rate) than recruiting parents from social media given personal contacts promoting more social bonds and therapeutic alliance relationship (44). To address technology literacy challenges in e-parenting technology use, including an introduction session to help parents sign-up/set up an account and learn about e-tool functionality can be a helpful strategy (43). To promote parents' participation frequency in use of eHealth tools/modules, including incentive strategies (e.g., use raffle tickets, win prizes, achieving badges, use of social network, promote online communities) and additional communication strategies (e.g., contact with the interventionists, use group messages, regular reminders, instant chat, technical support) are critical for improving effectiveness and usability (43, 49). To support parents learning and behavioral changes, eLearning with some forms of consultation or learning support (e.g., from implementers or other experienced parent-peers) and integrating parents' preference of learning styles/activities (e.g., working in groups with similar aged children, geographic locations) can bolster parenting behavioral changes or support (49, 53, 56).

Usability

Eight out of 14 parent-focused interventions reported eHealth usability. Three key lessons were gleaned from the findings: (1) frequency of eHealth usage would be higher when the accessibility of the digital devices is high and easy to use (in format that matches with target users' life style), and when resources/contents were relevant and more interactive (43) (49); (2) full completion rate for all modules/session increases (35%–66%) when the eHealth interventions are well designed (using short modules [15–30 minutes/per module], includes five or more sessions, and includes multiple communication supports (e.g., 20 minutes/per contact) (42, 47, 49–50, 51, 56, 60); and (3) when social network/e-community and optional technology-assisted communication tools were included, the likelihood to complete a minimum dose of intervention and user satisfaction can generally increase (50, 51, 56).

User-Engagement Strategies and Usability in Health Worker eLearning/e-Training Design

In training health workers (i.e., school staff, pediatric providers), one important lesson gained was that eLearning using web-based and offline video approaches were found to be equally effective in training. This is especially relevant to LMIC contexts, given challenges in internet access in many regions. Furthermore, interactive web-based education that also included other learning support (e.g., a discussion forum, opportunities to interact with consultants/child psychiatrists, web-conferencing, performance

TABLE 2 | eHealth user engagement strategies, usage patterns and acceptability evidence.

(a) eHealth user engagement strategies (Lessons also relevant to low- and middle-income countries (LMICs))**

eHealth in Contexts	User-Engagement Strategies
eHealth in Parenting Intervention Context	• **Parent recruitment** *via* **social media vs. general practices****: Parents recruited from general practices tend to stay on to the program for longer time than parents recruited from social media (given established social bonds or therapeutic alliance relationship) (44) • **Strategies for addressing Technology literacy****: For families with low technology literacy or not use technologies on regular-basses, including one introduction session in the beginning of parenting program to help sign-up a private group account, and demonstrate online tool functionality can be helpful (43) • **Privacy/Safety strategies**:** Parents prefer respectful communication and information sharing. Contents that they or other parents share should be careful chosen and appropriate. Parents felt comfortable sharing parenting information with an anonymous group (43) • **Motivators or incentive strategies to promote e-parenting technology use****: (i) promoting relationship tides between parents and the online communities/social networks (44, 56); (ii) including a social network group in e-parenting intervention (social network as a sharing community); (iii) inclusion of Facebook "events", (iv) including incentive approaches (e.g., raffle tickets, win prizes, gaming approach/achieving badges) to promote participation motivation, (v) having more contact with interventionist through social media channels (group messages, regular reminders, instant charts) (43, 49) • **Learning Engagement for Parents****: i) parents prefer working in group that have more similarities between parents themselves and other parents (e.g., similar-aged children, geographic locations); ii) parents commented that it would be helpful to see more examples of the skills that other parents are participating (from interventionist or other parents) (43); iii) web-based eLearning with some forms of consultation or learning support (from earlier cohort of parents or implementers) can promote parents' skill learning and total number of session completion rate (49, 53, 56)
eLearning in Provider/System Context (for PCPs or School Teachers)	• **Web vs. offline eLearning strategies****: For staff e-training, both web-based interactive education (WBIE; including a discussion forum to interact with consultants, and a web conference with a child psychiatrist) and the video-based education (TVBE; including receiving text, but not in-person connection) can be effective eLearning approaches (e.g., both types of eLearning had more nonstigmatized concepts than the control). However, the WBIE interactive approach was more effective than the TVBE noninteractive approach (e.g., in knowledge gain, fewer stigmatized concepts/opinion). Results suggesting adding a **discussion forum** and **web conferencing** can have more knowledge gain, but not on changing attitudes (61). • **A multicomponent eLearning strategy****: a three-component distance-learning can be effective, which includes web-based education [3 15-min modules], collaboratively consultation with child mental health experts, and performance feedback report/calls (71) • **Co-developing training/educational materials**** is an important way for designing educational resources that included a strong patient voice, meet nurse learning needs, and ensures the content is relevant, appropriate and sensitive to both the recipient of care and those responsible for its delivery (72)
E-Screening & E-Service Decision Support (in School Health Service or Primary Care Context)	• **Integration of two-step triage procedure is a good and acceptable way to set up preventive behavioral health care in schools****. The two-step triage includes a digital screening conducted by health assistants (task-shifting to community health workers) and a referral or additional service conducted by health professionals for those screened positive (task-sharing) (63) • **Patient portal enrollment and engagement strategies (in primary care)****: **i)** Use a navigator to demonstrate the patient portal to parents can increase the sign-up rate and address parent's technology literacy barrier (64); **ii)** Provide computers in the waiting-room and using waiting-room attendant (e.g., gap year students or retirees paid close to minimum wage, who can help interview families with limited literacy or can be charged with entertaining children, modeling appropriate adult-child interaction, implementing Reach and Read) that address family technology access and technology literacy gaps to improve enrollment and portal use (56%) in comparing to a reminder option (which give parents an appointment reminder card, including information on how to log-in to PEDS online and request to complete screens before the next scheduled visit) (44%) (66); • **Web- vs. On-site kiosks approach for setting up Patient Portal**: Many parents who sign up for patient portal also wanted to have the access of patient portal (for their child) *via* on-site kiosks (64) • **Integration of Previsit screening with EHR Decision Support:** *Parents like this approach when*: **i)** the digital approach is easy to use; ii) the screening highlighted the areas of concern that the doctor needed to touch on/discuss during the well-child care visit; **iii)** the screening questions relevant to their needs/questions (which remind them areas of concerns they may discuss with providers or areas of child health issues that they have not thought of; iii) completing the screener in advance that improve visit efficiency. *Providers like the approach when***: **i)** reducing the workload**; ii)** a summary report was provided to discuss with parents; **iii)** comprehensive screening questions were used (e.g., inclusion of mental health and other nonphysical health issues on the screener) that eliminating the need for the PCP to take the time to assess these issues (65, 67)
E-Communication in Care Team Collaboration Context	• **e-Strategies for trust-relationship between patients and care team members****: including names, photos, and definitions of treatment team members (e.g., role) can promote parent ability to correctly identify the care team, trust relationship, and care satisfaction (68) • **Four strategies to enhance pediatric care team communication****: 1) development of standard process for e-Handover; 2) reduction of overproduction and defects by "Making it Easy to Follow the Standard" and by providing resident/care team education; 3) eliminating waste in wait and search times (*by improve use of EHR for communication*, e.g., supplying care team members with providers' phone number and prefer methods of contact); and 4) aligning the incentive with those performing the work (70)

(*Continued*)

TABLE 2 | Continued

(b) eHealth Usage Patterns and Acceptability Evidence

eHealth in Contexts	**eHealth Usage Patterns and Acceptability**
eHealth in Parenting Interventions	• **Safe-Care Facebook Social Support group:** Use Frequency: Families with computers at home were more likely to check Facebook regularly (e.g., 3 times weekly) than families that relies on public facilities (e.g., computer in library; e.g., participate in some weeks). Parents commented on the content that they enjoyed viewing (of others' postings) within the group including parenting resources, links to websites, and supportive comments to and from other parents (43) • **Web-PMT (7 self-paced parenting sessions)**: 66% completed all 7 sessions, 22% completed 3–6 sessions, 16% completed fewer than 3 sessions. 69% families with two parents participated together (42) • **ezPARENT (6-sessoin Parenting program self-administrated modules)** (in the US): On average, parents spent 37.2 min per module (SD = 22.2); the mean number of program visits was 13.6 (SD = 8.6; range 2–49). Average length of time per visit was 14.1 min (SD = 17.1). Participants completed on average 82% of the modules (out of 6 total modules) (47). • **Triple P Online Community (TPOC) (8 online modules + social media + incentive in the US)**: online modules were access through numerous channel, such as agency computer lab (70%; home computer (54%), cell/smart phone (51%), work or school computer (33%), iPad or tablet (31%), friends' computer (21%), free WiFi (restaurant, 20%), public library computer (16%). The complete rate for the entire 8-module program was 36–51% (higher rate when smartphone is available, in later cohort/with support from earlier cohort)(71) • **Triple P Brief (TPOL Brief)-(Self-directed 5 modules, with optional technology assisted communication tools** (e.g., text prompts reminder, send module summary *via* email): 62% completed at least the recommended minimum dose (introductory module + one exemplar module), 53% completed 3 or more, 45% completed 4 or more, 40% completed all 5, 13% completed introductory only, 25% did not completed any. Average module completion time was around 2 hours for the introduction and 45min for the exemplar modules which is longer than expected, indicating that parents were explored optional extra material. 88% rate the program as good, and 77% were at least satisfied with the program. Parents with high disagreement over parenting were less likely to complete minimum dose of intervention (50, 51) • **TPOL-with weekly Telephone support (8 weekly online module + telephone consultation)**: parents in the TPOLe condition completed significantly more modules and higher satisfaction than directed TPOL (M = 5.62 and 3.25; 47% vs. 23% completed all 8 modules). Mean module completion time was 63 minutes. TPOLe group participated in 4.36 (SD = 2.53) clinical telephone support session on average. Average call duration was 24 minutes (SD = 8). There was a significant correlation between the number of telephone consultations and number of online modules completed (56) • **Online-Cool Little Kids parenting program (8 online modules + telephone consultation when requested):** Online program use was lower than the high attendance rates generally observed for the group parenting program when delivered through a university research clinic. Only 1/3 of parents attended most sessions (53) • **BRAVE-ONLINE (eCBT; 10 online sessions for children, and 5–6 online sessions for parents)**: On average, by 6-month follow-up, children and adolescents had completed 5.9 of 10 sessions (SD = 2.9) and parents had completed 4.56/6 (SD = 1.7)(child parent program) and 2.95/5 (SD = 1.9) sessions (adolescent parent program); 35% and 41% had completed all their sessions at the time of the follow-up (60)
eLearning for Providers or Teachers	• For **school-based e-Training** (for promoting teacher mental health in LMICs), the **attrition rate was high across all group**: 31% for WBIE and 52% for TVBE (might be due to high rates of teacher absenteeism and time unavailability due to high workloads). If participated, the impact was positive after receiving training (61) • **For Pediatric care-based eLearning**: 79% completed all 3 educational presentations. There were on average two phone, email, or in-person consultations with ADHD experts per month. 57% clinicians participated in at least one performance feedback call. Use of Care Assistant were more frequent in intervention (36% use at least 5 times, and 19% use at least 10 times) than in Control (31% use at least 5 time, and 15% use at least 10 times). Intervention clinicians who participated in at least one performance feedback call were more likely to send out parent rating scales than intervention clinicians who did not participate (relative difference of 14.2 percentage points (71).

(*Continued*)

feedback calls/report) can further promote health workers' skill learning, behavioral changes, and session completion rate (61, 71). For content design, codeveloping E-educational materials/content between health workers and targeted children/families can better meet health workers' needs, and ensure the content is relevant, appropriate and sensitive to both the recipients of care and those responsible for its delivery (72).

Usability

E-learning in LMICs has been found to be more challenging than e-Learning in developed countries, with a lower reach/usage rate in LMICs (i.e., 48%–70% reach in LMIC-Brazil vs. 79% in developed countries). Reasons for low reach include high rates of staff absenteeism, workloads, and time constraints, all of which indicate the importance of addressing contextual barriers in eLearning designs (61, 71). When performance feedback sessions were provided (to offer in-person consultation/support to answer trainees' questions about e-Learning content or to promote use of skill after eLearning), just over half (57%) of trainees participated in at least one feedback call. Those who used feedback calls were more likely to adopt the skills learned in eLearning (71). Findings suggest the importance of standardizing feedback sessions as part of the eLearning delivery models.

User-Engagement Strategies and Usability in Designing Integrated e-Screening and Electronic-Service-Decision-Support Tools for Primary Care

To promote provider and parent use of an integrated e-screening and decision support tool (with triage function), user-engagement strategies targeting parent users and care provider

TABLE 2 | Continued

(b) eHealth Usage Patterns and Acceptability Evidence	
eHealth in Contexts	**eHealth Usage Patterns and Acceptability**
E-Screening & E-Service Decision Support (in School Health Service or Primary Care Context)	• **Schools using the 2-step triage procedure to set up preventive child behavioral health service,** they provide more accessible service to students (measured by increasing utilization of/contacts # with school health service professionals than the schools not using 2-step triage. **This approach is also perceive as an more appropriate approach to support children with special needs** (63) • **Implementation of Pediatric Screening by Providers (use of PEDStestOnline (**www.pedstest.com/online): PEDS (evaluation of developmental status) was most commonly used (100%), followed by PEDS : DM (evaluate developmental milestones) (41%) and M-CHAT (Autism screening)(21%). Use of the M-CHAT spiked around 18months of age and remained high in the months surrounding 24 months of age. The screening use decreased ager 3 years of age (66). • **Staffing for Implementing Pediatric-Screening:** Receptionists/medical technician stations were often served as the point for dissemination clipboards/screening measures (at check-in). Next, skilled nurses often in charged with entered parents' responses into PEDS Online, offering an interview if forms were incompleted (clarified parents' comments and answers to items)or if evidence of limited literacy was present (66) • **Patient Portal Usage (for screening and health record management)**: In the US, less than 50% clinics implemented web-portal. For the clinics that implemented, % family used portal varied (range of family reached was 35%–100%), and only 10% use previsit screening. English speaking parents were more likely to use the online portal and screening thank non-English speaking families, but no difference in presence or absence of porta use due to parents' level of education or poverty. Among the users, about 70% of parents reported that they planned to use the patient portal again for their child (after sign-up). Since activation, median use was 0.8 times per month. A two-year tracking among disadvantaged populations found 81% of patients who activated their accounts accessed the portal twice or more (64) • **Parent use of previsit screening tools**: Parents indicated high acceptability of the screeners. Nearly 90% trusted the security of the screener, and 87% thoughts their answers would be confidential; 92% thought the screener was a good way to ask routine questions, 95% were comfortable with the mental health questions, and 89% thought the screener helped with sharing of concerns (65)
E-Communication in Care Team Collaboration	• **After implementation of EHR-Care team introduction system**, parents showed improved rate for correctly identifying care team physicians (71% s 28%). Most parents (79%) and care-team members (87%) also reported that subjects' ability to identify care team members impacted their satisfaction and trust relationship (68) • **Communication compliance and process significantly improve after implementation of e-handover communication Tools:** 15 out of 19 services have improved communication; satisfaction increase from 17% to 678%–7%) (69); 81% of PCPs were followed and confirm that e-handover communication was received (70); the Tools significantly simplify the care process (measured by 68% of PCP reported significantly reducing paper work time, and reduction of redundant data from 52%) (69)

users (including physicians, coordinated implementers) need to be considered. Efficient strategies that have been identified to promote patient-portal use/enrollment and use of previsit screening for their children include: use of navigators/waiting-room attendants (to demonstrate, assist sign-up, support parents who have low literacy), providing computers/on-site kiosks in waiting rooms, using reminder cards (with specific requests, instructions and information for using e-screening), keeping digital functions easy to use, making screening questions relevant to parents' needs, and summarizing areas for further attention (or highlighting areas for further discussion with health providers) (64–67). To promote provider uptake and use of integrated e-screening and decision support tools in pediatric care (for behavioral health promotion), providing training on the digital tool use (with clear explanation of functions and clinical workflow processes) and providing tools that have multiple benefits in meeting providers' needs (e.g., reducing workload, improving clinical efficiency, a summary report to discuss with parents, including comprehensive screening questions that eliminating the need for providers to take the time to assess) are critical to consider in design and delivery models (63, 65, 67).

Usability

Use of a parent portal for routine pediatric care is relatively new in pediatric behavioral health care settings in the US. Results of the PEDStestOnline study (that included 79 providers across 20 states, with data from 20,941 children ages birth to 8 years) indicated that 30% of sites implemented a web portal, and the rate of family enrollment varied by providers (reach 35%–100% families). Additionally, only 10% of eligible families used a previsit screening. The rate of uptake could depend on enrollment approaches. English-speaking parents were more likely to use the screening and online portal than non-English speaking parents, but there were no differences in portal use by parents' level of education or poverty (66). For clinics that provided computers in the waiting room, the uptake for portal use was higher (56%) than the clinics that used the appointment reminder approach of enrollment (44%). For those parents enrolled, about 70% reported that they planned to use the portal again for their child, and 81% continued accessing the portal two years after initial enrollment (66). Parents also reported high acceptability and satisfaction (e.g., about 90% trusted the security of the screener, 92% thought the screener was a good way to ask routine questions, 95% were comfortable with the mental health questions, and 89% thought the screener helped with sharing of concerns) (65).

User-Engagement Strategies and Usability in Designing Workflow Integrated e-Communication/Collaboration Tools

Applying collaborative and team-based care models to integrate behavioral health service in routine primary care is a recommended clinical practice guideline for pediatric care, especially for addressing the needs of special or high-risk pediatric populations (73–76). Although eHealth research in this area is limited, it is encouraging to see some new research. Based on two studies included in this scoping review, several user-engagement strategies have been suggested to enhance pediatric care team e-communication. These include (1) developing standard processes for communication and integrating these into e-communication tools; (2) providing care team education and making the standard of e-communication easy to follow; (3) improving use of EHR/e-tools for communication (e.g., supplying care team members' photos, expertise/roles, contact numbers, and preferred methods of contact in the e-tools); (4) providing incentives for those performing the work/or using the standard (68, 70).

Usability

The usability of e-communication tools and/or standardized e-handover tools were high. Parents and primary care-team members report improvement on their care satisfaction and trust relationship with the care team (79% and 87%, respectively) after use of the tools (68). For e-Handover communication tools, 79% of care teams reported improvement in team communication, increased satisfaction of care provided to pediatric patients (17% to 67–87%) and clinical efficiency (e.g., 68% reported a significant reduction of paperwork time and/or simplified care processes) (69, 70).

DISCUSSION

The purpose of this paper is to address knowledge gaps in applications of eHealth to promote young children's behavioral and mental health, as well as to understand how eHealth has been applied to broader dissemination of child mental health EBIs. The scoping review method was applied to generate a high-level overview of the eHealth strategies used and evaluated in child mental health contexts. A total of 32 articles (from 30 studies) were selected for this review. Through this review, eHealth applications (what purposes and problems to be solved) and digital- and user-engagement design strategies (how to best design) that have been applied and demonstrated efficacy/usability/effectiveness in child mental health promotion and prevention were identified and described. eHealth strategies that apply to parents, children, schools, and primary care practices were also identified. Based on our review, we noted several areas where additional eHealth research is needed to develop better approaches to support users in child mental health promotion and prevention both in global and LMIC contexts. In this section, we present research-practice implications for eHealth research that are relevant to LMIC contexts as well as discuss current limitations of the pediatric eHealth field.

Implications for eHealth Development and Design in LMICs

Four eHealth applications and design lessons can be drawn from this review. First, in identifying eHealth strategies to promote child mental health, three key eHealth design principles were consistently identified across three areas of eHealth applications (parenting, school, and primary care intervention). These include **i)** core intervention strategies that promote target users' child mental health knowledge and management skills can be developed and adapted from existing EBIs; **ii)** in promoting e-session/module participation (e.g., increasing adherence, preventing attrition), one or more supporting strategies that motivate participation, promote relationship-connection, or address technical challenges must be in place (e.g., using in-person contact, telephone contact, social media group access, gaming/incentives, automated email, messaging strategies); and **iii)** in promoting skill practice and behavioral change, consultation, and learning/supporting strategies that match target users' preferences and needs must also in place to ensure the practice changes (e.g., providing consultation support using a group or individual approach).

Second, in designing eHealth that fits LMIC contexts, two lessons can be drawn from the review: **i)** given limited web/internet availability in LMICs, the design of eHealth strategies should use mixed approaches by combining offline video-based psychoeducational learning/training (individual or group-based) with mHealth or/and face-to-face support strategies. This might be a feasible model given evidence that either web-based or offline, video-based education approaches can result in promising positive outcomes (61), and that the combination of mHealth and in-person support strategies (in group or individual formats) can be useful and highly acceptable for users with different levels of family risk or child mental health problems (42, 49, 56); **ii)** given that evidence has shown similarity in human behavioral change mechanisms across ethnic groups and high- and LMIC populations (14, 77), lessons learned from high-income country-based literature in user-centered design and user-engagement strategies (described in **Table 2**) are likely to be relevant and applicable to populations in LMICs. However, eHealth design and strategies may need to be tailored to local contexts and to be more thoroughly evaluated.

Third, the potential for applying eHealth strategies as cost-efficient approaches to address healthcare barriers is high. This scoping review demonstrates that a body of pediatric health research has successfully transported nondigital EBIs to eHealth formats, and has demonstrated the feasibility and effectiveness of this approach in high-income country contexts (24). There are also studies showing evidence of the cost-benefit of eHealth interventions in LMIC settings (78). These findings are encouraging as more EBI literature emerges.

Fourth, from our review, we noted ways that eHealth can be conceptualized and applied as multicomponent/multicontext digital strategies/solutions to promote child mental health. For eHealth to be effective, many eHealth interventions need to integrate multiple components, such as including strategies to promote mental health knowledge, practice and skills. Also, many eHealth interventions need to consider and address needs across multiple contexts, such as considering both family/home (e.g., a child's home), service provider contexts (e.g., primary care, schools), and linkage of both contexts. The multicontext concept is particularly useful in current mental

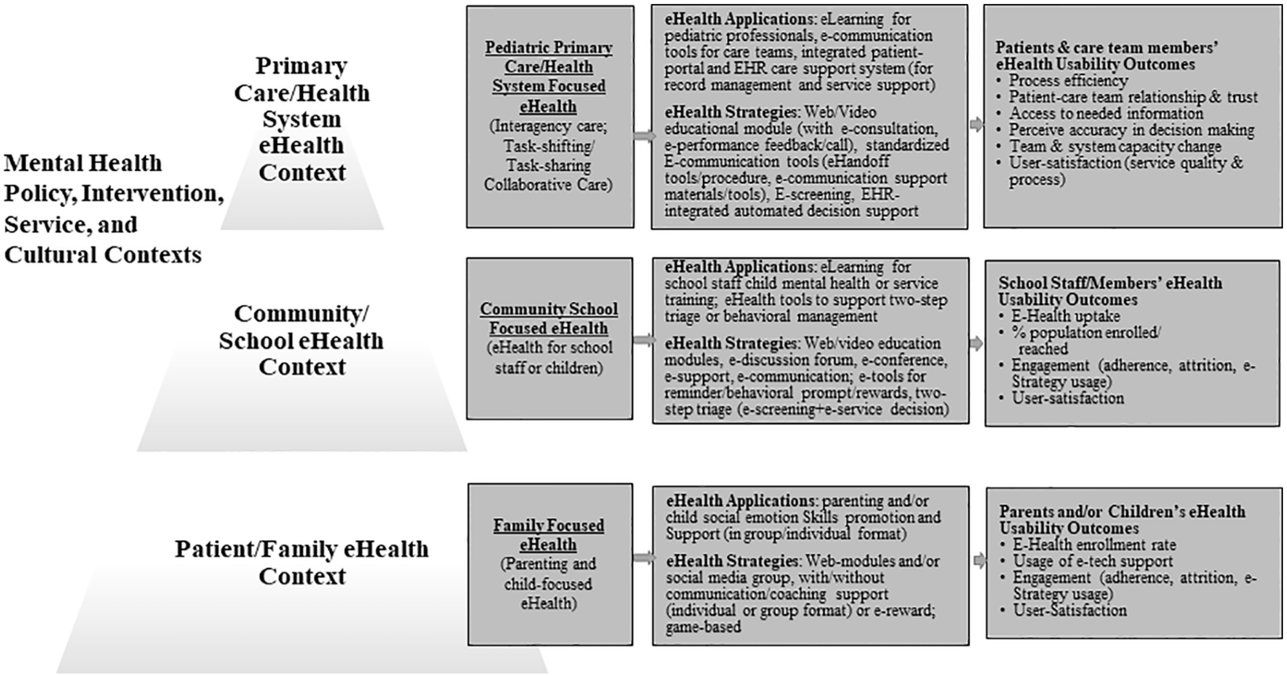


FIGURE 3 | A multicontext framework for child mental and behavioral eHealth. The proposed framework is developed from this eHealth literature synthesis. This framework considers implementation contexts and processes that described in the WHO (2009) Service Pyramid Model (79), and Proctor et al.'s (80) implementation framework.

health intervention service development research given a growing emphasis on linking mental health services from home to communities and health systems, and applying collaborative and team-based care models to integrate mental/behavioral health service in routine primary care and community settings (including the Mental Health Gap Action Program/mhGAP mental health service model suggested by the WHO, which suggests the application of collaborative, task-shifting and task-sharing implementation strategies in the provision of mental health services in LMICs) (73–76).

As an attempt to provide a working framework to guide future eHealth dissemination and implementation research, we summarize our lessons learned in an integrated multicontext framework for child mental and behavioral eHealth (**Figure 3**). The framework highlights key e-Health applications and strategies at individual/family, school system, and primary care contexts that can be applied to promote child mental health, as well as highlights eHealth usability/implementation outcomes to be considered and measured in future research in order to advance eHealth research and practice.

Limitations and Directions for Future Research

As a result of this review, we have identified several gaps where additional eHealth research is needed. One, eHealth capacity or system strengthening has rarely been discussed in the eHealth literature or in child mental health research. Given limited eHealth research in LMICs, building eHealth research and system capacity are needed (using the approaches suggested above). eHealth capacity building at the policy/governmental, academic, community, and technology-sector levels will can develop the needed workforce and expertise in designing user- and population-centered eHealth solutions. Two, well-designed high-quality evaluations, such as applying experimental designs to eHealth intervention outcomes studies, are still lacking. More research is needed to map out specific components/approaches of eHealth and associated benefits that can be applied to future development of behavioral health interventions. Three, to advance eHealth research, methodology, and measurement tools for assessing eHealth contexts, target users'/agencies' readiness for eHealth intervention (e.g., technology resources, technology literacy), and eHealth usability and implementation outcomes (e.g., user-engagement level, user-centeredness, usability) need to be further developed. Having better measurement tools and consistent methodology will facilitate cross study comparisons and better mechanism testing research. Four, although telehealth and messaging/texting is not included in this review, given growing applications of these strategies in middle-income countries (81), we suggest a separate scoping review to better understand the applications and stand-alone/unique impacts of these approaches on child health and/or mental health. It will be especially important to consider the impact and applications of telehealth/messaging in those populations that have better access to these eHealth strategies as well as better literacy.

CONCLUSION

As child mental health issues continue to require complex health service and healthcare policy solutions, it will become increasingly important to develop eHealth solutions that consider multiple contexts and integrated multicomponent solutions. This paper provides several new directions to address eHealth programming and methodological gaps related to eHealth research. The scoping review and framework not only provide guidance on how eHealth-related contexts and implementation/usability outcomes can be conceptualized, but also how eHealth mechanisms can be integrated into more robust implementation designs. As has been reiterated, more research is needed to elucidate both cross-setting and multisetting eHealth strategies and mechanisms. In particular, systematic and long-term follow-up research will strengthen understanding of eHealth strategies to advance eHealth implementation effectiveness, sustainability, and system and population-level mental health outcomes.

AUTHOR CONTRIBUTIONS

K-YH, DL, JN, S-Che, KG, DM, AS, S-Cho, EK, CT, and AM contributed conception and design of the study. K-YH, DL, JN, and S-Che were involved in the acquisition, analysis, and interpretation of data. K-YH wrote the first draft of the manuscript. K-YH, DL, S-Che, KG, AS, and AM contributed to manuscript writing. All authors contributed to manuscript revision, read, and approved the submitted version.

FUNDING

This research was supported by grant NIH/NCATS 1UL1TR001445 from the National Institutes of Health (NIH), and R21 MH110001-01 and U19MH110001-01 from the National Institute of Mental Health (NIMH). The reviews and opinions expressed in this article are solely those of the authors and do not necessarily represent the views of NIH. This review relied on publicly available documents and, therefore, was exempt from Institutional Review Board determination.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2019.00806/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 20 November 2019
doi: 10.3389/fpsyt.2019.00859

Chronic Maternal Depressive Symptoms Are Associated With Reduced Socio-Emotional Development in Children at 2 Years of Age: Analysis of Data From an Intervention Cohort in Rural Pakistan

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Background: Maternal depression affects a high proportion of women during the antenatal and postnatal period in low- and middle-income countries. While maternal depression is recognized as a significant risk for poor early child development that warrants interventions, the effects of chronic maternal depression on children's development are less understood.

Objective: To determine the association of chronicity of maternal depressive symptoms and early child development in a rural population in southern Pakistan.

Materials and Methods: This study employs data from the "Pakistan Early Child Development Scale-Up Trial," a randomized controlled study that evaluated the integration of responsive stimulation and nutrition interventions in a community health service. In the present analysis, linear regression was used to test the effects of chronicity of high maternal depressive symptoms on children's early development (n = 1205 mother-infant dyads). Children's development was assessed using the Bayley Scales of Infant and Toddler Development at 24 months of age. Maternal depressive symptoms were assessed at baseline and every 6 months using the Self-Reporting Questionnaire.

Results: No significant associations were observed between chronic maternal depressive symptoms and child cognitive, language, or motor development after adjusting for parental characteristics, the caregiving environment and socioeconomic variables. A negative significant association between chronicity of high maternal depressive symptoms and child socio-emotional development (β coefficient −2.57, 95% CI: −5.14; −0.04) was observed after adjusting for the selected variables.

Conclusions: The results suggest that interventions designed to promote early child development should also integrate repeat screening for depression and longer-term psychosocial support for mothers.

Keywords: maternal depression, chronicity, early child development, low- and middle-income countries, cognition, language, motor skills, socio-emotional development

Edited by:
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Specialty section:
This article was submitted to
Public Mental Health,
a section of the journal
Frontiers in Psychiatry

Received: *30 June 2019*
Accepted: *01 November 2019*
Published: *20 November 2019*

Citation:
De Oliveira CVR, Rasheed M and Yousafzai AK (2019) Chronic Maternal Depressive Symptoms Are Associated With Reduced Socio-Emotional Development in Children at 2 Years of Age: Analysis of Data From an Intervention Cohort in Rural Pakistan.
Front. Psychiatry 10:859.
doi: 10.3389/fpsyt.2019.00859

INTRODUCTION

Maternal depression affects 15.6% and 19.8% of women during antenatal and postnatal periods respectively in low- and middle-income countries (LMIC) (1). Low socioeconomic status (SES), inadequate support for mothers, stress, exposure to violence, and natural disasters may increase risks for depression, which might explain some differences in the higher reported prevalence of maternal depression in LMIC compared with high-income countries (1). Like many other LMIC, Pakistan has high reported rates of antenatal depressive symptoms ranging from 16.8% to 55.9% (2, 3) and of postnatal depressive symptoms ranging from 28.8% to 36% (4, 5). Several studies in Pakistan have investigated depression following child birth (6). In one study, chronicity of depression was assessed and found half of Pakistani mothers who were depressed in the third trimester of pregnancy continued to be depressed one year after giving birth (7).

Maternal depressive symptoms (e.g., distress, depressed mood, loss of interest, and enjoyment) are associated with poor child health, nutrition, and growth outcomes, which may be the result of poorer maternal sensitivity and responsiveness to her child's needs as a result of depression (1, 8, and 9). A systematic review and meta-analyses of the effect of maternal depression or depressive symptoms on child growth in LMIC reported that maternal depression was associated with early childhood underweight and stunting compared with children whose mothers were not presenting depression or depressive symptoms (10). Specifically, in Pakistan, studies have reported an increased risk of underweight (11) and diarrhea episodes (12), and an increased risk of early cessation of exclusive breastfeeding (13) in infants of depressed mothers compared with infants of psychologically well mothers.

With respect to child development outcomes, a meta-analysis of 14 studies from 10 countries reported an association between maternal depressive symptoms and lower cognitive scores in early infancy (14). In a study from the United Kingdom, children whose mothers had high depressive symptoms during the early postpartum period had higher levels of dysregulated infant behavior and lower cognitive scores compared with children with non-symptomatic mothers (15). In Canada, a study showed that maternal depressive symptoms increased risks of children having low receptive vocabulary and displaying inattention or physical aggression at 4 to 5 years of age compared to children whose mothers had no depressive symptoms (16). Fewer studies from LMIC have investigated the relationship between maternal depression and child development. However, one study from Vietnam reported higher symptoms of common mental disorders (including depression and anxiety) in mothers during the third trimester of pregnancy were significantly associated with low scores for children's motor development (17).

A key factor believed to moderate the effects of maternal depression on child outcomes is the chronicity of depressive symptoms (18). At present, only a few studies from high-income countries have examined the effects of the chronicity of maternal depressive symptoms on children's health and development outcomes. The limited evidence suggests that young children exposed to more severe and chronic maternal depressive symptoms have greater health and development problems. For example, Prenoveau and colleagues found that chronic maternal depressive symptoms during the first two years postpartum (assessed at 3, 6, 10, 14, and 24 months) were related to poorer behavior and emotional negativity in children at 24 months of age (18). Similarly, Cents and colleagues modeled trajectories of maternal depressive symptoms during pregnancy through the first 36 months of life and identified that children of mothers with higher depressive symptoms had significantly more behavior problems than children of mothers with lower trajectories of depressive symptoms (19). Brennan and colleagues observed the severity and chronicity of maternal depressive symptoms assessed during pregnancy and again when the child was 6 months old and 5 years old was significantly associated with child behavior problems (20). Cornish and colleagues reported that chronic maternal depression (assessed at 4, 12, and 15 months postpartum) was associated with lower infant cognitive and psychomotor development at 15 months of age, while brief depressive symptoms did not significantly impact the child's performance (21).

There is a need to evaluate the impact of chronic maternal depressive symptoms on child development outcomes in populations with greater risks of exposure to depressive symptoms. A number of other risk factors (e.g., fewer early learning opportunities) may further compound early development in such contexts. Understanding the contribution of these risks and their impacts on the developing child are critical to inform targeted intervention strategies to support parenting (22). The Pakistan Early Child Development Scale-Up Trial (PEDS-trial) was a pragmatic community-based cluster randomized factorial effectiveness trial evaluating the effects of early responsive stimulation intervention (with or without nutrition intervention) on child development in the first 2 years of life (23). The study found responsive stimulation (with or without nutrition) significantly benefitted children's cognitive, language, and motor development as well as parenting knowledge and practices, and caregiver-child interactions (23, 24).

With respect to maternal depressive symptoms, the PEDS trial found that 29% of mothers had high depressive symptoms and 12% expressed suicide ideation at the time of enrolment (<2.5 months postpartum) (24). The combined responsive stimulation and nutrition intervention had a modest significant effect on decreasing maternal depressive symptoms over time. However, the impact of chronicity of maternal depressive symptoms on children's development has not been reported. The objective of this study was to evaluate whether chronicity of maternal depressive symptoms affects child development at 24 months of age.

MATERIALS AND METHODS

Study Design, Setting, and Population

This analysis employs data from the "Pakistan Early Child Development Scale Up (PEDS)" trial implemented in district in Sindh province, Pakistan. This is a predominantly rural agricultural districts. Families are exposed to high levels of adversity. On average, the monthly household income was Pakistani Rupees 9826.60 (US$ 62.37 based on current exchange rates). One-third of households were food insecure. With respect to parental education, 68% of mother and 31% of fathers were illiterate. Childhood malnutrition was prevalent with 43% of children underweight and 61% of children stunted (short stature) by 24 months of age.

The PEDS trial was a cluster-randomized factorial effectiveness trial (23). A total of 1489 mother–infant dyads were enrolled at birth and 1391 mother-infant dyads were followed for 2 years (23). A birth cohort was recruited with their mothers from the study clusters. Births were identified by an independent surveillance team. Every infant born in the study area between April 1st 2009 and March 31st, 2010 was eligible for enrolment. Inclusion criteria for enrolment were infants <2.5 months of age without signs of disability who were born and living in the study cluster. Ethical approval was granted by the Ethics Review Committee of the Aga Khan University. The PEDS trial was registered at www.clinicaltrials.gov (NCT00715936).

This analytical sample included 1,205 mother-infants dyads. Criteria for inclusion were: (1) a completed child development assessment at 24 months; (2) the primary caregiver was the child's biological mother; and (3) mothers had an assessment for depressive symptoms at all five-time points (baseline, 6, 12, 18, and 24 months). The primary outcomes in this analyses was children's cognitive, language, motor, and socio-emotional development at 24 months of age.

Outcome Assessment and Covariates

Child Development

The primary outcome of interest was early child development (ECD) measured by the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III) when children were 24 months old. A trained team of assessors collected data on children's cognitive, language (receptive and expressive), motor (fine and gross), and socio-emotional development. Composite scores were reported and a higher score denotes better development. Inter-observer agreement was high for all domains of development (cognitive development: N = 84, R = 0.99, $p < 0.0001$; receptive communication: N = 83, R = 0.97, $p = 0.01$; expressive communication: N = 84, R = 0.97, $p = 0.001$; social-emotional: N = 81, R = 0.99, $p < 0.001$; fine motor development: N = 83, R = 0.97, $p < 0.0001$; gross motor: development N = 83, R = 0.95, $p < 0.0001$) (23).

Self-Report Questionnaire-20 (SRQ-20)

Maternal depressive symptoms were assessed using the Self-Reporting Questionnaire (SRQ-20) (25). The SRQ-20 is a screening tool designed to measure neurotic symptoms and includes symptoms of anxiety as well as depressive symptoms or psychological distress. The SRQ-20 is not a diagnostic instrument; however, it has been used to screen for risk of clinical depression. The SRQ-20 comprises 20 questions each scored either 0 or 1 to indicate whether an individual has not experienced the symptoms or has experienced the symptom in the past month. A higher score denotes an increasing number of depressive symptoms. In Pakistan, the validity and reliability for postnatal depression using an adapted version of the SRQ-20 has been reported, and a score ≥9 indicates risk of postnatal depression (26, 27). The validation and reliability work was conducted in a population in Punjab Pakistan, in a peri-urban population. The current population in Sindh shares common disadvantages and cultural similarities. Additionally, the language translation from Urdu to Sindhi was reviewed to ensure constructs retained meaning and an independent back translation was completed for quality assurance (24).

In this study, the SRQ-20 was administered by interview in a private space to mothers at five time points at baseline and when children were 6, 12, 18, and 24 months old. Inter-observer agreement for the SRQ-20 administration was high (N = 51, R = 0.99, 0.001) (24). Chronicity was defined with respect to high maternal depressive symptoms when a mother had two consecutive scores on the SRQ-20 of ≥ 9 (see **Table 1**).

Child Growth

Deficits in development are often seen in early childhood growth (28). Therefore, data on children's growth status were collected following standard protocols (29). Height was measured with a ShorrBoard© to the nearest 0.1 cm, and weight was measured with a Seca877 Digital Flat Scale with Mother/Child Function© to the nearest 0.1 kg. The technical error of measurement for height was 1.86%, (R = 0.99); and for weight was 0.71% (R = 0.99). Weight-for-age (WAZ) and height-for-age (HAZ) at 24 months old were reported in accordance with the World Health Organization growth standards. A score of ≤−2 denotes moderate-to-severe undernutrition.

Observation of Mother and Child Interaction (OMCI)

Quality of caregiver-child interactions is associated with benefits to children's development. Assessment of mother-child interaction was collected using the Observation of Mother and Child Interaction (OMCI) when children were 12 months old (30). The primary caregiver (typically the mother) was instructed to play with her child using a picture book while a trained observer rated a live 5-min interaction and scored frequency of behaviours. The tool comprises 19 items covering maternal affect, maternal touch, maternal verbalization, sensitivity, contingent responses, scaffolding, language stimulation, focus, child affect, child focus, child's communication efforts, and

TABLE 1 | Categories to describe chronicity of maternal depressive symptoms.

Category	Definition
No high depressive symptoms reported at any time point	Women with a SRQ-20 score <9 at each time point.
High depressive symptoms reported at a single time point	Women with a SRQ-20 score ≥9 for a single time point only.
High episodic depressive symptoms	Women with a SRQ-20 score ≥9 for 2 or more time points, but not continuously.
Chronicity of depressive symptoms	Women with a SRQ-20 score ≥9 for 2 or more consecutive time points.

mutual enjoyment. A high score denotes greater frequency of behaviours associated with good quality interaction. Inter-observer agreement was moderate-to-high (N = 81, R = 0.82, p < 0.001) (24).

Home Observation for Measurement of the Environment (HOME) Inventory

The Home Observation for Measurement of the Environment (HOME Inventory) is the most widely recognized and commonly used instrument to evaluate the quality of the caregiving and learning environment for young children (31). High scores on the HOME Inventory (the Infant and Toddler version) are associated with benefits to children's development (32). The HOME Inventory employs observation and interview methods to assess the following caregiving domains: responsivity, acceptance, organization, learning materials, involvement, and variety. A higher score denotes greater quality of the environment that supports early development and learning. In this analysis, we used HOME Inventory data collected when children were 18 months old. Inter-observer agreement was high (N = 96, R = 0.99, p < 0.001) (21).

Household Data

Data on household SES were collected from each enrolled household at baseline. A composite wealth index measure of a household's cumulative living standard was constructed using household asset data including ownership of a number of consumer items ranging from a television to a bicycle or car, as well as the source of drinking water, sanitation facilities, type of material used for flooring, and household income (23). Several studies have reported a significant association between low SES and poor outcomes in the child development (33).

Food security data were also collected from each household using a standardized questionnaire that asks about access and sufficiency of food among household members in the past 4-weeks. Food security describes a situation when the family has physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs for an active and healthy life as opposed to food insecurity when there is a situation of limited or uncertain availability of nutritionally adequate and safe foods (34).

Data on the number of siblings and birth order were used for this analysis. Siblings can promote an environment of support for child development, but depending on the order of birth may also influence the amount of attention that caregivers might provide to a child (35). Parental education data were collected on both mothers and fathers. The greater the number of years of formal education parents receive is positively associated with child development outcomes (22).

Statistical Analysis

Figure 1 shows the theoretical pathways of interest for the analysis. Stata 14.1 (StataCorp, College Station, Texas, USA) was used to perform the analysis. The dependent variables were the Bayley-III composite scores for children's cognition, language, motor and socio-emotional development. Chronicity of maternal depressive symptoms (i.e., no high depressive symptoms, single episode of high depressive symptoms, episodic high depressive symptoms, and chronicity of high depressive symptoms) was the exposure variable. For categorical outcomes, we used *t*-tests, one-way ANOVA, and χ^2 tests to visualize the relationship between exposures and continuous outcomes. The Shapiro-Wilk test, scatter-plots, and comparisons between mean and median values were used to assess the normality of continuous variables.

Four models for each child development outcome were analyzed using a step-wise approach. In the first model, exposure was tested adjusting for child characteristics (i.e., gender, height for age, weight for age, and birth order). In the second model, exposure was tested adjusting for parental education. In the third model, exposure was tested adjusting for variables that represented the child's caregiving environment (i.e., number of siblings, caregiving environment, and mother-child interactions). In the fourth model, exposure was tested adjusting for household SES and food security. Sixteen multiple linear regression models were

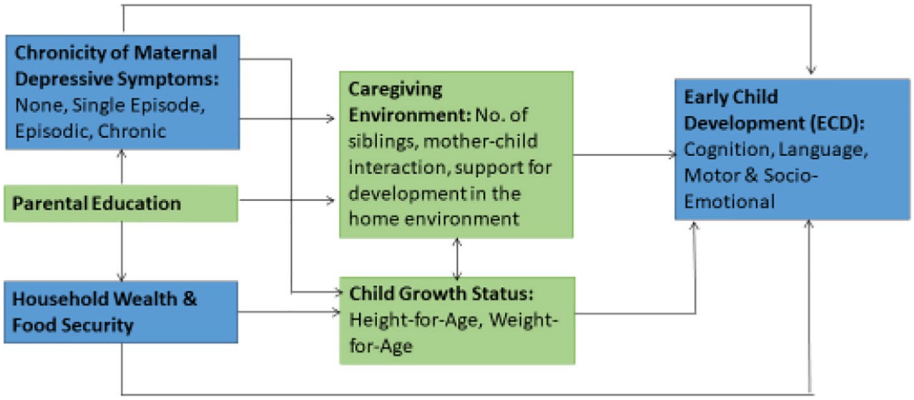

FIGURE 1 | Hypothesized pathways between maternal depression and child development. Adapted from Grantham-McGregor et al. (28).

used to estimate the effect of chronicity of maternal depressive symptoms on child development domains at 24 months of age. Models were controlled for clustering effects and intervention exposure. The missing data were included in the multiple models by creating missing-value categories. The fit of the model was ascertained by an examination of residuals, which did not show any potential harmful effects. Collinearity was examined by the correlation matrix.

RESULTS

A total of 1205 mother-infant dyads were analyzed. The characteristics of the participants are presented in **Table 2**. We observed that 35.5% of mothers had chronicity of high depressive symptoms, 11.7% had experienced episodic high depressive symptoms, and 22.3% had experienced a single episode of high depressive symptoms. A total of 69.5% of Pakistani mothers experienced high depressive symptoms during the first 24 months of her child's life.

TABLE 2 | Characteristics of the study population.

Variables	N	Value
		Mean (SD)
Bayley-III score of cognitive at 24 months[1]	1.205	78.48 (14.65)
Bayley-III score of language at 24 months[1]	1.205	82.95 (13.55)
Bayley-III score of social-emotional at 24 months[1]	1.205	94.00 (0.25)
Bayley-III score of motor at 24 months[1]	1.205	89.07 (16.99)
Height-for-age[1] (24m)	1.197	–0.84 (1.16)
Weight-for-age[1] (24m)	1.198	–0.81 (0.95)
Birth order[1] (Baseline)	1.205	3.49 (2.30)
Number of siblings[1] (Baseline)	1.205	4.18 (2.26)
HOME quality[1] (18m)	1.205	30.92 (5.41)
OMCI[1] (12m)	1.203	30.0 (8.61)
Wealth (Baseline)	1.199	0.01 (0.99)
		%
Chronicity of Maternal Depression Symptoms [2]		
No high depressive symptoms at any time point	367	30.5
Single high depressive symptoms	269	22.3
Episodic high depressive symptoms	141	11.7
Chronicity	428	35.5
Gender[2] (Baseline)		
Female	554	46.0
Male	651	54.0
Maternal education[2] (Baseline)		
No education	170	14.1
Primary and above	1.035	85.9
Father education[2](Baseline)		
No education	688	57.1
Primary and above	517	42.9
Food insecurity[2] (Baseline)	1.205	
Secure	771	63.98
Insecure	434	36.02

Continuous variable variable[1]; categorical variable[2]; HOME = Home Observation for Measurement of the Environment; OMCI = Observation of Mother and Child Interaction; Chronicity of Maternal Depression Symptoms = No high depressive symptoms at any time point refers to women with a SRQ-20 score <9 at each time point; high depressive symptoms reported at a single time point refers to women with a SRQ-20 score ≥9 for a single time point only; high episodic depressive symptoms refers to women with a SRQ-20 score ≥9 at 2 or more time points, but not continuously; and chronicity refers to women with a SRQ-20 score ≥9 at 2 or more consecutive time points.

In the multivariate analysis for cognitive development, adjusting for child characteristics, the results for the first model found that episodic and chronicity of high depressive symptoms were associated with poorer child cognitive development with a decrease in the β coefficient (episodic β coefficient −4.37, 95% CI: −7.15; −1.59; chronic β coefficient −2.73, 95% CI: −4.74; −0.73). This association remained in model 2 after adjusting for parental education only for the episodic high depressive symptoms, but not in models 3 and 4 (episodic β coefficient −2.02, 95% CI: −4.58; 0.52; chronicity β coefficient −1.02, 95% CI: −2.89; 0.85) after adjusting for the caregiving environment and household variables. In the final model we observed that only child HAZ, HOME, OMCI, and SES were significantly associated with child cognitive outcome (see **Table 3**).

For children's language outcome, the multivariable analysis in model 1, adjusting for child characteristics, showed that episodic and chronicity of high depressive symptoms were associated with a 2.5 and a 3.1 units decrease in the scale of language development (β coefficient −2.52, 95% CI: −5.10; −0.05, β coefficient −3.12, 95% CI: −4.98; −1.26). In model 2, after adjusting for parental education, this association was no longer significant (β coefficient −2.00, 95% CI: −4.56, −0.54; β coefficient −2.26, 95% CI: −4.12; 0.39). In the final model, only child HAZ, HOME, OMCI, and SES were significantly associated with children's language development (see **Table 4**).

Child motor development was associated with episodic and chronicity of high depressive symptoms in model 1 adjusting for child characteristics with decreases in the scale of 4.3 and 3.4 units respectively. This association remained significant only for episodic high maternal depressive symptoms in model 2, after adjusting for parental education. No significant associations were found in models 3 and 4 after adjusting for the caregiving environment and household variables respectively. In the final model, only child HAZ, HOME, OMCI, and SES were significantly associated with motor development (see **Table 5**).

There was a significant negative association between chronicity of high maternal depressive symptoms and child socio-emotional development in all four models tested (β coefficient −2.57, 95% CI: −5.21; −0.04) (see **Table 6**). The HOME Inventory and OMCI remained significant independent variables associated with socio-emotional development.

DISCUSSION

This study of a rural disadvantaged population in Pakistan employed repeated measures of maternal depressive symptoms. The results show 69.5% (N = 838) of children were cared for by mothers who experienced high maternal depressive symptoms during the first 24 months postpartum and 35.5% (N = 428) of these mothers, experienced chronicity of high depressive symptoms.

TABLE 3 | Multivariate analysis of maternal depressive symptoms and child cognitive development.

Variables	Model 1		Model 2		Model 3		Model 4	
	β[a]	CI[b]	*β*[a]	CI[b]	*β*[a]	CI[b]	*β*[a]	CI[b]
Chronicity of Maternal Depression Symptoms								
No high depressive symptoms at any time point	*1*		*1*		*1*		*1*	
Single high depressive symptoms	−1.44	−3.69; 0.79	−1.13	−3.35; 1.09	−.59	−2.92; 1.19	−0.59	−2.61; 1.43
Episodic high depressive symptoms	−4.37	−7.15; −1.59*	−3.79	−6.55; −1.03*	−1.87	−4.44; 0.68	−2.02	−4.58; 0.52
Chronicity	−2.73	−4.74; −0.73*	−1.78	−3.80; 0.22	−1.08	−2.95; 0.77	−1.02	−2.89; 0.85
Male	0.52	−1.09; 2.14	0.67	−0.93; 2.27	0.75	−0.72; 2.24	0.72	−0.73; 2.18
Height-for-age (24 m)	2.65	1.58; 3.72*	2.29	1.23; 3.36*	1.60	0.66; 2.64*	1.60	0.61; 2.59
Weight-for-age (24 m)	−0.27	−1.57; 1.01	−0.22	−1.51; 1.05	−0.20	−1.39; 0.98	−0.19	−0.73; 2.18
Birth order	−0.61	−0.97; −0.26*	−0.45	−0.80; −0.09*	−0.08	−1.12; 1.11	−0.09	−1.20; 1.00
Maternal education			−2.30	−3.48; −1.11*	−0.84	−1.96; 0.27	−0.76	−3.05; 1.51
Father education			−1.30	−2.26; −0.33*	−0.50	−1.40; 0.39	−0.02	−1.65; 1.61
Number of siblings					−0.27	−1.41; 0.87	−0.21	−1.34; 0.90
HOME quality (18 m)					0.74	0.59; 0.90*	0.62	0.47; 0.78*
OMCI (12 m)					0.33	0.24; 0.42*	0.26	0.17; 0.36*
Food insecurity							0.57	−1.11; 2.26
Wealth							1.96	1.07; 2.86*
N	1.205		1.205		1.205		1.205	
R^2-adjusted	.05		.08		.20		.22	

*[a]β-coefficient linear regression; [b]Confidence Interval; *P-value <0.05; HOME = Home Observation for Measurement of the Environment; OMCI = Observation of Mother and Child Interaction; Chronicity of Maternal Depression Symptoms = No high depressive symptoms at any time point refers to women with a SRQ-20 score <9 at each time point; high depressive symptoms reported at a single time point refers to women with a SRQ-20 score ≥9 for a single time point only; high episodic depressive symptoms refers to women with a SRQ-20 score ≥9 at 2 or more time points, but not continuously; and chronicity refers to women with a SRQ-20 score ≥9 at 2 or more consecutive time points.*

TABLE 4 | Multivariate analysis of maternal depressive symptoms and child language development.

Variables	Model 1		Model 2		Model 3		Model 4	
	β[a]	CI[b]	*β*[a]	CI[b]	*β*[a]	CI[b]	*β*[a]	CI[b]
Chronicity of Maternal Depression Symptoms								
No high depressive symptoms at any time point	*1*		*1*		*1*		*1*	
Single high depressive symptoms	−1.66	−3.74; 0.41	−1.37	−3.43; 0.68	−1.15	−3.05; 0.75	−0.69	−2.55; 1.16
Episodic high depressive symptoms	−2.52	−5.10; −0.05*	−2.00	−4.56; 0.54	−0.27	−2.65; 2.09	0.11	−2.23; 2.46
Chronicity	−3.12	−4.98; −1.26*	−2.26	−4.12; 0.39	−1.64	−3.37; 0.08	−1.17	−2.90; 0.54
Male	−0.51	−2.02; 0.98	−0.38	−1.87; 1.09	−0.33	−1.71; 1.04	−0.21	−1.55; 1.12
Height-for-age (24 m)	2.26	1.27; 3.25*	1.93	0.94; 2.92*	1.35	0.43; 2.27*	1.30	0.40; 2.21*
Weight-for-age (24 m)	0.12	−1.07; 1.32	0.17	−1.01; 1.35	0.16	−0.93; 1.26	0.11	−1.96; 1.19
Birth order	−0.51	−0.84; −0.18*	−0.36	−0.69; −0.03*	−0.34	−1.38; 0.68	−0.48	−1.49; 0.52
Maternal education			−2.14	−3.24; −1.05*	−0.84	−1.88; 0.18	0.16	−1.93; 2.27
Father education			−1.12	−2.00; −0.23*	−0.38	−1.22; 0.44	0.27	−1.22; 1.78
Number of siblings					0.15	−0.90; 1.21	0.26	−0.76; 1.30
HOME quality (18 m)					0.65	0.51; 0.80*	0.53	0.39; 0.67*
OMCI (12 m)					0.33	0.24; 0.41*	0.24	0.15; 0.32*
Food insecurity							0.06	−1.56; 1.54
Wealth							2.17	1.34; 2.99*
N	1.205		1.205		1.205		1.205	
R^2-adjusted	.05		.07		.21		.24	

*[a]β-coefficient linear regression; [b]Confidence Interval; *P-value <0.05; HOME = Home Observation for Measurement of the Environment; OMCI = Observation of Mother and Child Interaction; Chronicity of Maternal Depression Symptoms = No high depressive symptoms at any time point refers to women with a SRQ-20 score <9 at each time point; high depressive symptoms reported at a single time point refers to women with a SRQ-20 score ≥9 for a single time point only; high episodic depressive symptoms refers to women with a SRQ-20 score ≥9 at 2 or more time points, but not continuously; and chronicity refers to women with a SRQ-20 score ≥9 at 2 or more consecutive time points.*

TABLE 5 | Multivariate analysis of maternal depressive symptoms and child motor development.

Variables	Model 1		Model 2		Model 3		Model 4	
	β^a	CI^b	β^a	CI^b	β^a	CI^b	β^a	CI^b
Chronicity of Maternal Depression Symptoms								
No high depressive symptoms at any time point	*1*		*1*		*1*		*1*	
Single high depressive symptoms	−1.59	−4.19; 0.99	−1.34	−3.92; 1.23	−0.13	−3.55; 1.28	−0.61	−3.00; 1.77
Episodic high depressive symptoms	−4.29	−7.50; −1.07*	−3.71	−6.91; −0.50	−1.79	−4.81; 1.22	−1.58	−4.59; 1.42
Chronicity	−3.45	−5.77; −1.13*	−2.55	−4.49; 0.22	−1.90	−4.10; 0.28	−1.42	−3.63; 0.78
Male	1.15	−0.71; 3.03	1.31	−0.54; 3.17	1.36	−0.38; 3.11	1.40	−0.32; 3.12
Height-for-age (24 m)	3.32	2.08; 4.55*	2.99	1.76; 4.26*	2.37	1.20; 3.54*	2.18	1.01; 3.34*
Weight-for-age (24 m)	−0.40	−1.89; 1.09	−0.37	−1.86; 1.11	−0.38	−1.78; 1.00	−0.36	−1.74; 1.01
Birth order	−0.70	−0.94; −0.04*	−0.55	−0.96; −0.14*	−1.08	−2.40; 0.23	−1.20	−2.49; 0.09
Maternal education (b)			−1.72	−3.10; −0.34*	−0.29	−1.60; 1.02	0.52	−2.16; 3.22
Father education (b)			−1.63	−2.74; −0.51*	−0.77	−1.83; 0.28	−0.09	−1.82; 2.02
Number of siblings (b)					0.75	−0.58; 2.10	0.85	−0.47; 2.17
HOME quality (18 m)					0.74	0.56; 0.92*	0.59	0.41; 0.77*
OMCI (12 m)					0.37	0.26; 0.48*	0.30	0.18; 0.41*
Food insecurity (b)							−0.13	−2.12; 1.85
Wealth							2.60	1.55; 3.66*
N	1.205		1.205		1.205		1.205	
R^2-adjusted	.06		.07		.18		.21	

*$^a\beta$-coefficient linear regression; ^{b}Confidence Interval; *P-value <0.05; HOME = Home Observation for Measurement of the Environment; OMCI = Observation of Mother and Child Interaction; Chronicity of Maternal Depression Symptoms = No high depressive symptoms at any time point refers to women with a SRQ-20 score <9 at each time point; high depressive symptoms reported at a single time point refers to women with a SRQ-20 score ≥9 for a single time point only; high episodic depressive symptoms refers to women with a SRQ-20 score ≥9 at 2 or more time points, but not continuously; and chronicity refers to women with a SRQ-20 score ≥9 at 2 or more consecutive time points.*

TABLE 6 | Multivariate analysis of maternal depressive symptoms and child socio-emotional development.

Variables	Model 1		Model 2		Model 3		Model 4	
	β^a	CI^b	β^a	CI^b	β^a	CI^b	β^a	CI^b
Chronicity of Maternal Depression Symptoms								
No high depressive symptoms at any time point	*1*		*1*		*1*		*1*	
Single high depressive symptoms	−1.33	−4.17; 1.51	−1.11	−3.95; 1.72	−0.94	−3.72; 1.83	−0.93	−3.72; 1.84
Episodic high depressive symptoms	−3.83	−7.36; −0.31*	−3.41	−6.94; 0.10	−2.08	−5.56; 1.38	−1.85	−5.36; 1.65
Chronicity	−3.82	−6.36; −1.28*	−3.14	−5.71; −0.57*	−2.63	−5.15; −0.10	−2.57	−5.14; −0.04*
Male	−0.03	−2.05; 2.04	0.10	−1.94; 2.15	0.22	−1.78; 2.23	0.32	−1.68; 2.33
Height-for-age (24 m)	1.69	0.34; 3.05*	1.44	0.08; 2.80*	1.01	−0.33; 2.35	1.05	−0.30; 2.40
Weight-for-age (24 m)	0.68	−0.95; 2.32	0.71	−0.92; 2.35	0.75	−0.85; 2.36	0.56	−1.04; 2.18
Birth order	−0.49	−0.94; −0.04*	−0.37	−0.83; 0.07	−0.47	−1.99; 1.03	−0.52	−2.03; 0.99
Maternal education			−1.55	−3.06; −0.03*	−0.52	−2.03; 0.98	−0.18	−2.95; 3.33
Father education			−1.02	−2.24; −0.20*	−0.46	−1.68; 0.74	−0.81	−3.05; 1.42
Number of siblings					0.25	−1.29; 1.80	0.28	−1.25; 1.83
HOME quality (18 m)					0.56	0.35; 0.76*	0.60	0.39; 0.82*
OMCI (12 m)					0.20	0.07; 0.32*	0.21	0.08; 0.34*
Food insecurity							0.72	−1.59; 3.04
Wealth							0.21	−1.01; 1.45
N	1.205		1.205		1.205		1.205	
R^2-adjusted	.03		.04		.08		.08	

*$^a\beta$-coefficient linear regression; ^{b}Confidence Interval; *P-value <0.05; HOME = Home Observation for Measurement of the Environment; OMCI = Observation of Mother and Child Interaction; Chronicity of Maternal Depression Symptoms = No high depressive symptoms at any time point refers to women with a SRQ-20 score <9 at each time point; high depressive symptoms reported at a single time point refers to women with a SRQ-20 score ≥9 for a single time point only; high episodic depressive symptoms refers to women with a SRQ-20 score ≥9 at 2 or more time points, but not continuously; and chronicity refers to women with a SRQ-20 score ≥9 at 2 or more consecutive time points.*

The findings demonstrated that chronic high depressive symptoms in mothers were not associated with early child cognitive, language, and motor development at 24 months of age after adjusting for other risk factors in the child's immediate caregiving environment (including caregiver-child interactions, and home environment, household SES, and child height-for-age). However, chronically elevated maternal depressive symptoms were significantly negatively associated with child socio-emotional development and this association was maintained after adjusting for the other risks.

Previous studies have reported postpartum depression was associated with deficits in children's socio-emotional development (36). The early years are a sensitive period for children's development, influenced by the mother's ability to respond to her child's emotional cues (37). If a mother has reduced emotional availability as a result of depression, she may not have the disposition to interact and respond appropriately to her child's developmental needs. Maternal emotional disposition, sociability, and assertiveness have been found to predict a higher level of children's social-emotional development (38), while postnatal depression is associated with low levels of children's social and emotional development (39) increasing risks for hyperactivity (40), internalizing problems (41), and offspring depression (42).

Only a few studies have previously measured the chronicity of maternal depressive symptoms and associations with child outcomes. Children of mothers with persistent and severe depression are at an increased risk for behavioral problems by 3.5 years of age, and lower mathematics grades and risk of depression during adolescence compared with children whose mothers had normal levels of depressive symptoms below the threshold (43). Dahlen found recurrent episodes of maternal depression in multiple periods of the child life had impacts on poorer mother-infant interactions, reductions in children's reading scores, less-developed interpersonal skills, and more externalizing behavioral problems in third grade than children whose mothers were not depressed (44). Chronic or persistent postpartum depression can severely compromise the ability of mothers to provide care and foster secure attachment, even more if the symptoms of depression persists in sensitive periods of children's development in which the impact on the child's emotional development is potentially more threatened (45).

To the best of our knowledge, the present study is the first from a LMIC to corroborate the evidence from high-income countries on chronicity of high maternal depressive symptoms and early socio-emotional development. However, significant associations between chronic high depressive symptoms and child cognitive, language, or motor development were not found, and for which other risk factors (e.g., early learning opportunities) in the environment likely contribute more significantly. This emphasizes the need for comprehensive intervention approaches that target the needs of the child and the caregiver in contexts of complex disadvantage with exposure to multiple risks. Our findings may be generalizable to similarly disadvantaged populations and contexts with high risk of maternal depressive symptoms. However, caution is warranted given challenges that may limit comparisons. A key issue in the literature is the wide variation in classification of chronicity of maternal depression and its measurement. This variation can make comparisons between studies challenging. However, in general, it can be concluded that severity and persistence of maternal depressive symptoms are associated with poorer early child development outcomes.

The study findings have implications for both programs and research. A program intending to promote and protect early childhood development should consider effective interventions that meet the needs of the child (e.g., support for early development and learning) and care for the primary caregivers for young children, especially the mental health of mothers who are typically the primary caregivers. Training of health professionals on mental health, particularly community health workers, could help to prevent complications and address mental health topics with women. Interventions to promote mental health implemented by lay workers or community health workers in LMICs have been found to be effective as noted in the recent Lancet Commission on Global Mental Health and Sustainable Development (46). Such an approach would require the establishment of a screening system for early identification of caregivers with risks for depression. The treatment of maternal depression is a public health urgency and cannot be neglected in services designed to support young children. With respect to further research, further longitudinal research is needed to elucidate impacts on children's development in the life course and identify windows of opportunities for early intervention to mitigate negative effects. It is also necessary to have evidence that can distinguish effects on children's development of chronicity of depression starting in the antenatal and postnatal periods.

The strengths of this study include the large sample, availability of confounding and moderating variables, and the repeated measures of maternal depressive symptoms. This study also has some limitations. While the self-reporting questionnaire SRQ-20 to measure depressive symptoms, a clinical diagnosis of depression was not available. However, a high risk and prevalence of depressive symptoms is reported in studies of maternal depressive symptoms in LMICs which warrants investigation. Further research on a population with clinically diagnosed depression will also be needed to guide targeted intervention work. In addition, information about the antenatal period where depressive symptoms may also affect child outcomes were not collected.

CONCLUSIONS

This study contributes to the growing knowledge about symptoms of chronic maternal depressive symptoms and the impact on children's socio-emotional development. These results support the need to establish a plan to provide emotional and psychological support for mothers in the sensitive early period of development in the life of the child.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Aga Khan University Ethical Research Committee. Written informed consent for children to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

AY was the PI of the PEDS trial and conceptualized the present analysis and contributed to the drafting of the manuscript. CO analyzed the data and drafted the manuscript. MR reviewed a draft of the manuscript.

ACKNOWLEDGMENTS

We are thankful to all participants involved in this study. We are grateful to all the mothers and families in district Naushero Feroze, Sindh, who consented to be interviewed and without whom this study would not have been possible.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 26 November 2019
doi: 10.3389/fpsyt.2019.00841

Child and Adolescent Mental Health Services in South Africa—Senior Stakeholder Perceptions of Strengths, Weaknesses, Opportunities, and Threats in the Western Cape Province

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Specialty section:
This article was submitted to Child and Adolescent Psychiatry, a section of the journal Frontiers in Psychiatry

Received: *08 April 2019*
Accepted: *23 October 2019*
Published: *26 November 2019*

Citation:
Mokitimi S, Jonas K, Schneider M and de Vries PJ (2019) Child and Adolescent Mental Health Services in South Africa—Senior Stakeholder Perceptions of Strengths, Weaknesses, Opportunities, and Threats in the Western Cape Province. Front. Psychiatry 10:841. doi: 10.3389/fpsyt.2019.00841

Background: There is general consensus that child and adolescent mental health services in low- and middle-income countries have an urgent need to be strengthened. However, this require not only a universal understanding of services and service needs, but also in-depth local knowledge to inform relevant service strengthening. This study sought to explore the perspectives of senior child and adolescent mental health service providers and policy-makers in one South African province to identify strengths, weaknesses, opportunities, and threats to child and adolescent mental health services.

Methods: A qualitative study was conducted with 13 purposively sampled senior child and adolescent mental health service providers, senior managers, and policy-makers from the Western Cape Province, using a half-day multi-stakeholder workshop format. Verbal and written data were recorded and coded for analysis. Two independent raters performed thematic analysis.

Results: The comprehensive bio-psycho-social approach and strong specialist child and adolescent mental health service units were identified as strengths. Limited capacity, workload demands, inadequate and inequitable resource allocation, poor implementation of early detection and preventative policies, and overall neglect of child and adolescent mental health services, were identified as weaknesses. Collaborative working between child and adolescent mental health and pediatric services, and increased provincial government (Department of Health) involvement, were identified as potential opportunities to develop and strengthen child and adolescent mental health services. Silo working of agencies, societal stressors, inadequate infrastructure and other resources, and lack of dedicated funding for child and adolescent mental health, were identified as threats to the development of services.

Conclusions: This analysis of strengths, weaknesses, opportunities, and threats reinforced the widespread neglect of child and adolescent mental health services in South Africa and highlighted areas for further research and advocacy. There is a clear need to explore the perspectives and experiences of service users and providers to generate comprehensive multi-stakeholder evidence that may identify positive "tipping points" for improvements and strengthening of child and adolescent mental health service delivery, training, and research.

Keywords: child, adolescent, mental health services, health systems, tipping point, South Africa, Africa, low- and middle-income countries

INTRODUCTION

Mental health disorders are the number one leading burden of disease in children and adolescents (1) affecting 10–20% of children and adolescents around the world. Strikingly, 50–80% of all adult mental health disorders emerge before the age of 18 (2). Mental health disorders in children and adolescents have a negative impact on their development and wellbeing. Children with mental health disorders often experience challenges in education and learning, in their transition to adult life, and in their potential to live fulfilling and productive lives (3). Child and adolescent mental health (CAMH) is therefore increasingly recognized as a public health priority (4–7). In spite the fact that 90% of the world's children and adolescents live in low- and middle-income countries (LMICs), the evidence-base for the burden of child and adolescent mental disorders in LMICs is very limited (8–11) and suggests a clear lack of policy development and policy implementation, very limited research, and very limited resources for CAMH services (11, 12).

Even though there is a clear global need for CAMH policy and service development, it is imperative that an understanding of these global needs is combined with local knowledge about health and care systems, existing resources, and local policies, particularly in LMICs. This requires a multi-level synthesis of available data including situational analysis of existing infrastructure, resources and workforce (13), evaluation of existing policies and policy implementation, and multi-level views of existing services and future service needs (13). A key component of local knowledge is therefore to have a thorough understanding of the perspectives of a broad range of stakeholders—from senior policy-makers and CAMH leadership, to clinicians who provide and families who receive services at the grassroots. **Figure 1** shows a graphic representation of the multiple levels that will require integration to understand and strengthen CAMH services. Levels include the "policy landscape" (international, national and regional/provincial knowledge, and perspectives on CAMH-relevant policies), the "resource landscape" (international, national, and regional/provincial knowledge about available infrastructure, human resources, and funding), the "senior stakeholder landscape" (international, national, and regional/provincial knowledge and perspectives of decision-makers and senior leadership in CAMH), "provider perspectives and experience" (of those working at the grassroots of service delivery), and "user perspectives and experience" (of families and young people who seek clinical services in a particular setting). A careful understanding is required at all levels relevant to a specific service in order to know how to approach service strengthening. Such understanding can identify the strengths, weaknesses, opportunities, and threats (SWOT) affecting the provision of optimal CAMH services.

South Africa is classified as an upper-middle income country by the World Bank (14). Importantly, South Africa is also recognized as the country with the greatest income inequality in the world (13) and as a result, has some of the greatest health disparities in the world (15). The 2018 mid-year population estimates showed that the country had a total population of 57.7 million of which 21.8 million (37.8%) were estimated to be under the age of 19 (16).

The global prevalence rate of CAMH disorders is estimated to be between 10 and 20% (5, 7). There are no prevalence studies on the mental health of children and adolescents in any Sub-Saharan African country, including South Africa. However, in South Africa Kleintjes and colleagues (17) generated estimates of children likely to have diagnosable CAMH disorders, based on international data. They showed that 17% of children were likely to have a diagnosable CAMH disorder (17), with the most common being generalized anxiety disorder (11%), followed by posttraumatic stress disorder and major depressive disorder/dysthymia (both 8%), oppositional defiant disorder (6%), and attention deficit/hyperactivity disorder (5%). Of note, no estimates were made for autism spectrum disorder and other main categories of neurodevelopmental disorders.

The last situational analysis of South African CAMH services took place in 2005 (11) and showed that there was a national CAMH policy (18), but that none of the South African provinces had a specific CAMH policy or implementation plans based on the national policy. There was inadequate and inequitable distribution of CAMH resources with most services located in the metropolitan areas of the country, limited specialist human resources for CAMH services, and a lack of human resource training of generalist workers in CAMH (11). The impact of stigma, the low priority of mental health, and lack of attention to the link between poverty and mental ill-health were proposed as factors that influenced the lack of developments in CAMH services (11).

In a recent investigation, we reviewed all national and provincial mental health policies to establish the current "policy landscape" for CAMH in South Africa (19). In South Africa, policy is set at national level, and implementation is delegated to provincial level, in acknowledgement of the highly diverse

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Abbreviations: MH, mental health; CAMH, child and adolescent mental health; CA, children and adolescents; DoH, Department of Health; LMIC, low- and middle-income countries; SWOT, strengths, weaknesses, opportunities, and threats.

socio-economic and socio-cultural diversity of the country. Apart from the 2003 national CAMH policy (18), no South African provinces had CAMH policies or implementation plans to support the national CAMH policy (19). The main focus of the provincial health policies was on HIV/AIDS, tuberculosis, and on maternal health and child mortality. Policy documents made little or no mention at all of CAMH services (19). Our findings therefore confirmed the ongoing neglect of CAMH at policy level, in spite of the burden of CAMH disorders.

As a next step toward an evidence-based, comprehensive CAMH service model in South Africa, it was therefore important to examine the "senior stakeholder landscape" (see **Figure 1**) by investigating local knowledge about CAMH services as perceived by senior and experienced policy makers and service providers. We elected to use the Western Cape Province as a case study for other low- and middle-income settings, given that it is the location of our clinical and academic activities. The Western Cape Province is one of nine provinces in South Africa, with Cape Town as the capital city. It has an overall population of 6.6 million (16), of which 2.2 million (33.3%) are under the age of 19 (16). The Western Cape and Gauteng Provinces are better resourced in terms of specialist CAMH services compared to other South African provinces (9). **Figure 2** shows a map of South Africa, indicating the location of provinces, and the location of specialist (tertiary) CAMH services. Specialist services are available in Gauteng (four service units), in Kwa-Zulu-Natal (one service unit), and in the Western Cape (three service units). There are no state/government-funded specialist CAMH services outside these centers.

In this study we therefore sought perspectives of senior CAMH service providers, managers, and policy-makers from the Western Cape Province of South Africa, to identify their multi-stakeholder perspectives of strengths, weaknesses, opportunities and threats (SWOT) in relation to CAMH services. Work by the Nobel Prize-winning economist Thomas Schelling in the 1970s (20) and popularized by Gladwell in 2000 (21), generated the concept of a "tipping point," defined as "the critical point in a situation, process or system beyond which a significant and often unstoppable effect or change takes place." The construct has been applied in various fields, including sociology and health systems research (22, 23). Gladwell (21) used the concept of tipping points to refer to potentially small events that could lead to significant change. We therefore set out to identify potential positive and negative "tipping points" that might be able to inform CAMH service strengthening activities from the data.

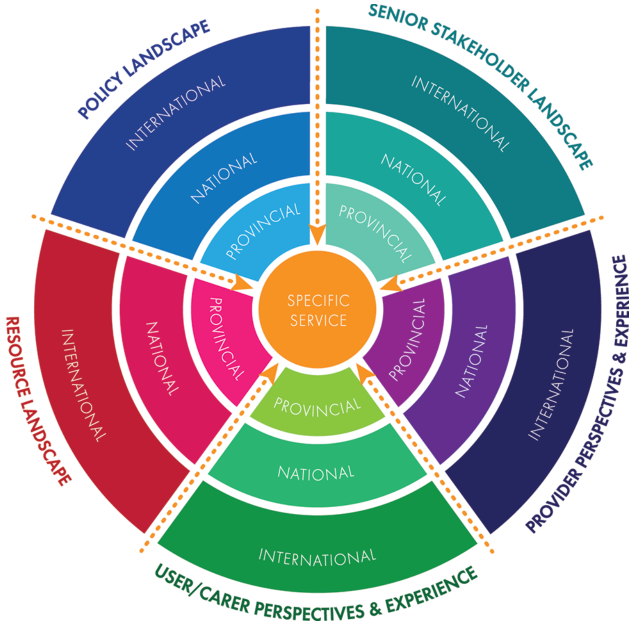

FIGURE 1 | The multi-level integration of knowledge required to understand and strengthen child and adolescent mental health services.

MATERIAL AND METHODS

Study Design

A qualitative study was conducted with purposively sampled senior CAMH service providers, senior managers, and policy-makers from the Western Cape Province, using a half-day multi-stakeholder workshop format.

Study Participants

Purposive sampling was used to select relevant stakeholders with insight into CAMH issues to ensure representation across a wide range of experienced CAMH service providers and policy makers at all levels of care. We aimed to include policy-makers from the Western Cape Department of Health (DoH), senior CAMH managers, and senior practitioners from the three metropolitan sub-structures (Southern/Western sub-structure, Mitchell's Plain/Klipfontein sub-structure, Northern/Tygerberg sub-structure), from the rural districts (Cape Winelands, West Coast, Overberg, Eden and Central Karoo), and from all levels of care in the province (community, district, and tertiary care) were invited to participate. Details of the Western Cape, its rural districts and metropolitan sub-structures are shown in **Figure 2**.

A list of all mental health professionals and their contact details was obtained from the Provincial Mental Health Directory (24). The stakeholders were recruited telephonically and *via* email. A total of 24 multidisciplinary stakeholders were invited to participate.

Setting and Data Collection

Information sheets containing details about the study and consent forms were emailed to participants prior to a face-to-face workshop held in March 2017. Willing participants who were not able to attend the meeting in person were provided with the key questions and were asked to return written comments for inclusion in data analysis. All consent forms were collected on the day of the workshop. The stakeholder engagement workshop was conducted in a quiet, private space at a central venue.

Participants were divided into three groups of four professionals each. Groups were structured to ensure a mix of professionals from the following categories: policy-makers, clinical psychologist, mental health nurses, nursing managers, child and adolescent psychiatrists, and medical officers (medically qualified professional without formal qualifications in psychiatry). Each small group was asked

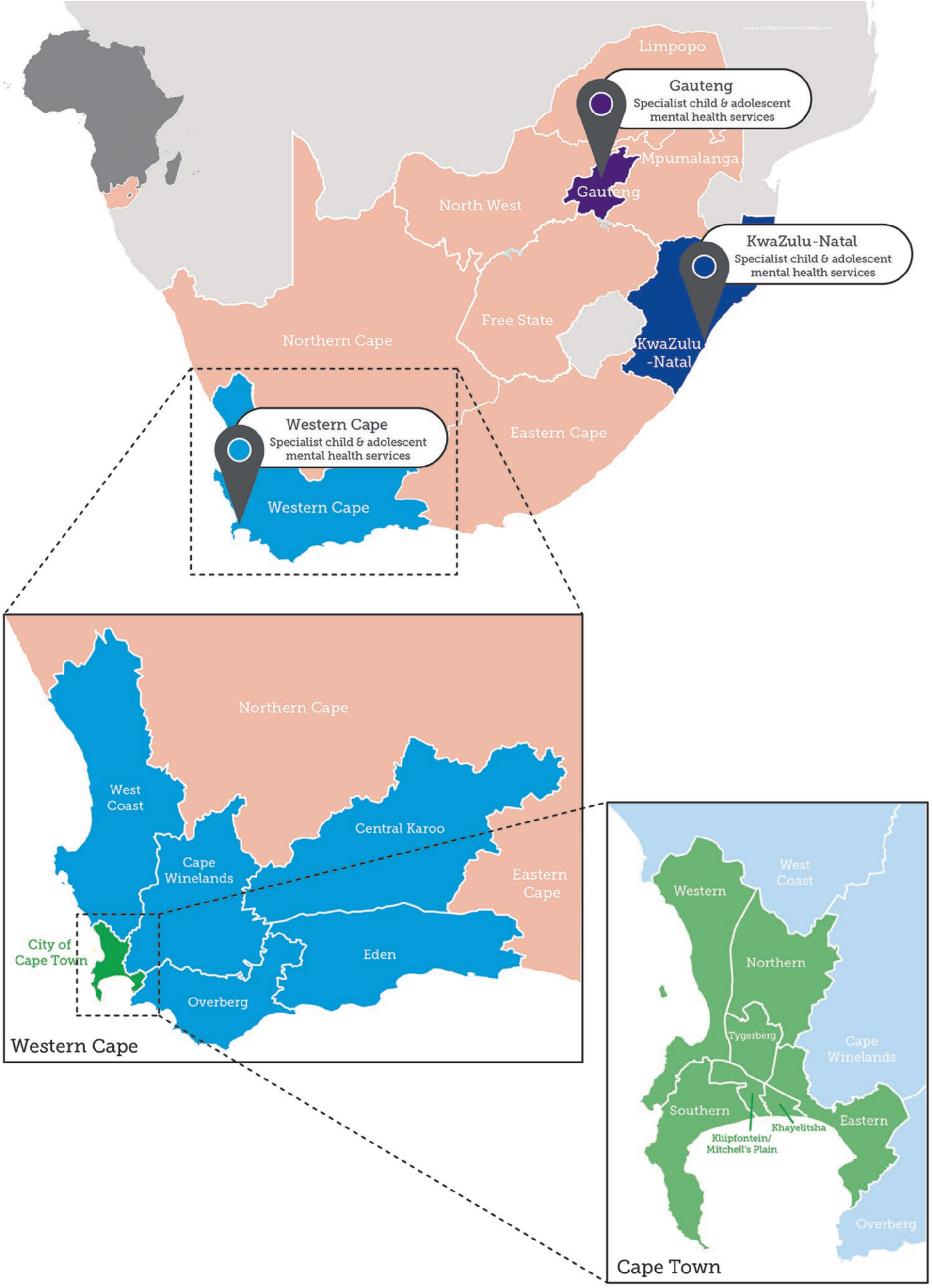

FIGURE 2 | A map of South Africa indicating the location of specialist child and adolescent mental health services (indicated as pins on the map). The enlarged area shows the Western Cape Province and indicates the details of the different health districts and metropolitan sub-structures where the specialist CAMH services are situated.

to perform a SWOT analysis in their group. Following small-group work, each group fed back to the large group, which led to additional large group discussion around similarities and differences identified. The lead author facilitated the large group discussions.

South Africa has 11 official languages. English is spoken as primary language by a small proportion of the population (~10%), but it is the accepted language of communication at professional and senior stakeholder level. All participants were asked in advance of the workshop about their English proficiency, and all indicated that they were fluent in English. For this reason, all discussions were held in English. Discussions were audio-recorded and field notes were taken during the discussions and consolidated after the session. The duration of the stakeholder engagement workshop was three hours.

Four main aspects were discussed: strengths, weaknessess, opportunities and threats in CAMH services in the Western Cape.

We conceptualized these as "current" positives (strengths) and negatives (weaknesses) *versus* "future" positives (opportunities) and negatives (threats). Member checking was done during the discussion process where the facilitator summarized the key points from the discussions and asked the participants to confirm these. Two of the authors (MS, PdV) were observers of the workshop but were not active participants in the discussions.

Data Analysis

Audio recordings were analyzed using thematic analysis (25, 26) through NVIVO 11 (QSR) qualitative data software package (27). Relevant sections were transcribed verbatim in NVIVO. Data were coded, and codes were subsequently grouped into themes. The coded transcripts were analyzed by running query reports, and primary document tables were produced of the codes and themes to explore the issues from the discussions.

To strengthen the trustworthiness of analysis data triangulation was performed. Written notes from the workshop were made by the research team and these were compared with the data written by group participants, and the audio recordings from the workshop and corroborated the findings of this study. Furthermore, to ensure objectivity of the data two researchers (SM and KJ) coded all the data independently. The two researchers met regularly to compare and discuss their findings until consensus and saturation was reached. For this reason, no quantitative measure of agreement was calculated.

Informed Consent and Ethics Approval

This study was approved by the University of Cape Town Human Research Ethics Committee (HREC 188/2016) and permission to conduct the study was received from the Western Cape DoH and the Red Cross War Memorial Children's Hospital. The study adhered to the principles as set out in the Helsinki Declaration (28). All participants were provided with a participation information sheet, and all provided written, informed consent before participating.

RESULTS

A total of 13 multidisciplinary stakeholders (12 face-to-face and 1 written response) participated in this study. Eleven invited professionals did not participate. The reasons for non-participation were stated to be time constraints and occupational requirements. Participants included one policy-maker, four advanced senior mental health nurses, two nursing managers, three child and adolescent psychiatrists (consultants), one medical officer (medically qualified professional without formal qualifications in psychiatry), one general psychiatrist, and one senior clinical psychologist. All the participants were experienced CAMH service providers. The years of CAMH service experience ranged from 4 to 20 years. The results of the multi-stakeholder engagement workshop are presented below according to the SWOT identified in thematic analysis.

Strengths

Two main strengths emerged from the analysis. These were recognition of a comprehensive bio-psycho-social approach, and strong specialist CAMH service units. **Table 1** provides a summary of the identified themes and subthemes illustrated with representative quotes from participant transcripts.

TABLE 1 | A summary of the themes illustrating the strengths of child and adolescent mental health (CAMH) services.

Overarching theme	Sub-themes	Illustrating examples/quotes
Comprehensive bio-psycho-social approach	Holistic across ages	*"combined child and adolescents … holistic across ages … excellent tertiary services"* ***[Child and adolescent psychiatrist]***
	More than custodial care	*"…we have a good vision for how CAMH services should exist, that it's more than custodial care…"* ***[Child and adolescent psychiatrist]***
Strong specialist CAMH service units	Clearer referral care pathways within CAMH services	*"The referral care pathways are clearer now … like the person staying in Crossroads* cannot just refer a child to the Child and Family Unit …"* ***[Child and adolescent psychiatrist]***
	Links between tertiary and primary CAMH services.	*"Training is provided for community Mental Health providers by the tertiary CAMH specialists…"* ***[Child and adolescent psychiatrist]*** *"Weekly supervision is provided for community Mental Health nurses on Fridays once a month…"* ***[Child and adolescent psychiatrist]***
	Improved training for primary CAMH services	*"There are joint CAMH case discussions at least once a term across the platform…"* ***[Child and adolescent psychiatrist]***
	Committed CAMH specialists	*"…people like us … who still care about it and … I mean there are people … committed … committed workforce. I mean nobody does this for fun…"* ***[Child and adolescent psychiatrist]***
	Highly skilled tertiary CAMH services	*"…There's some highly qualified multidisciplinary teams at all level …"* ***[Child and adolescent psychiatrist]*** *"We've got skilled and experienced tertiary layer…"* ***[Child and adolescent psychiatrist]***
	Strong academic support and involvement for CAMH services	*"academic support … I mean they [university] do not just teach, but they do"* ***[Child and adolescent psychiatrist]***

**Crossroads: denotes a high-density residential area in Cape Town.*

Comprehensive Bio-Psycho-Social Approach

CAMH services were described as having a "comprehensive bio-psycho-social approach," meaning the generation of a thorough formulation and intervention plan based on a comprehensive evaluation of the biological, psychological, and social needs of a child and their family. CAMH services were seen as "holistic" because they included preventive, promotive, and curative elements, and were offered at all levels of care—primary, secondary, and tertiary levels. The services were provided for ages 0–18 years, and assessment and interventions were described as developmentally appropriate to the needs of the child.

Strong Specialist Child and Adolescent Mental Health Service Units

The existing specialist units were described as understanding that CAMH services do not only comprise of custodial care but involve a holistic approach. The specialist units were said to offer in-patient and outpatient services and a range of psychotherapeutic interventions. Senior stakeholders reported that CAMH services had evolved a lot since 2014. For 3 years (2014 to 2017) CAMH services consistently had skilled and experienced clinicians. The specialists were described as passionate about what they do, striving to provide effective CAMH services despite the challenges. These CAMH specialists were described as having a vision of how services should be, and this vision was reportedly shared and implemented very effectively in various forums that meet on a regular basis. These meetings include highly qualified multidisciplinary team members from all levels of care. Participants described that information about CAMH services and referral care pathways were shared across the districts and across disciplines, thus raising awareness about CAMH services and referral pathways. The goodwill from the district level was recognized as a facilitator to sharing of best practices and increased awareness of CAMH services.

Participants commented that the Western Cape Province was advantaged compared to other provinces in the country with three strong and well-structured tertiary CAMH units: Lentegeur Child and Family Unit (linked to Stellenbosch University), the Tygerberg Child and Adolescent Psychiatry Unit (linked to Stellenbosch University), and the Division of Child and Adolescent Psychiatry at Red Cross War Memorial Children's Hospital (linked to the University of Cape Town). The three tertiary specialist CAMH units were described as the strengths and pillars of CAMH services in the Province. They were also perceived by the participants as the strongest CAMH units in the country with a reputation for providing excellent tertiary CAMH services that are comprehensive across ages.

CAMH services were receiving some support from the Western Cape Government DoH which included interactions and discussions with CAMH specialists about CAMH services. There were also interactions between CAMH specialists and district managers about CAMH services, and in some districts, multidisciplinary health teams had been formed that included a CAMH specialist. CAMH services also received support from the academic systems (University of Cape Town and Stellenbosch University) through training, clinical supervision, and research.

Tertiary CAMH specialists offered support to mental health providers and non-specialists in primary and secondary care levels through supervision and training. As a result of these interactions, referral care pathways had been improved in recent years.

Weaknesses

Five main weaknesses emerged from the analysis—limited capacity, workload demands, inadequate and inequitable resource allocation, poor implementation of early detection and preventive policies, and overall neglect of CAMH services. **Table 2** provides a summary of the identified themes and subthemes illustrated with representative quotes from participant transcripts.

Limited Capacity

Participants described a generally lack of capacity in the Western Cape within the DoH, the Department of Education (WCED), and the Department of Social Development (DSD). The WCED and DSD were described as having high workloads and a shortage of resources to meet the demand. DoH staff felt that WCED and DSD referred a lot of inappropriate cases to CAMH services, adding to the workload for the DoH. Participants referred to insufficient training on CAMH within all three departments, and expressed concern about lack of standardized best practices across CAMH services. Limited human resources within the DoH for CAMH services were described, particularly at primary and secondary levels of care. Non-specialists were described as being overwhelmed by the CAMH workload, despite their goodwill.

Workload Demands

There were complaints about the "stats" requirements for staff in CAMH services. In this context, "stats" is a local term used to refer to the workload expectation in services, in other words the requirement to see a certain number of patients per day in a service. Service providers felt that these "stats" requirements did not correlate with the work that they do. The pressure on service providers to meet the "stats" quotas set by senior managers was seen to be at the expense of the quality of service that was needed by users. As a result, clinical staff felt as if they were not doing enough when low numbers were reflected. Service providers felt strongly that the type of "stats" quotas for CAMH services should reflect and capture all the qualitative therapeutic work done and not just be about numbers. Participants reported that generalists in primary health care settings and secondary level were also unable to manage their "stats" demands given the high workload associated with CAMH cases.

Inadequate and Inequitable Resource Allocation

Participants reported that there were no outpatient, inpatient, or inpatient emergency facilities for CAMH services at secondary level (that is, at district/regional hospital level). Children were still mixed with adults at primary and secondary levels of care. CAMH resources were still unequally distributed in the Western Cape thus limiting access to CAMH services for those who do not live in Cape Town close to specialist facilities. Participants further commented that there were fewer resources and access to CAMH services for areas with the lowest socioeconomic status, including rural areas.

TABLE 2 | A summary of themes illustrating the weaknesses in child and adolescent mental health (CAMH) services.

Overarching theme	Sub-theme	Illustrative example/quote
Limited capacity	Insufficient training in CAMH services	*"…there's insufficient focused training on child and adolescent psychiatry…"* ***[Nursing manager]***
Workload demands	Workload measurement not correlating to child psychiatry	*"Stats* is a problem … if my output is about 25 patients per month…that doesn't speak to my workload … doesn't speak to how many crises I've had in between…"* ***[Advanced senior psychiatric nurse]***
Inadequate and inequitable resource allocation	Unequal distribution of CAMH services	*"…we're dealing with a large gap of socioeconomic status … so there's a large variation of accessibility for services and knowledge about the services etc…"* ***[Child and adolescent psychiatrist]***
	Dependency on NGOs**	*"I think that too many things are left to NGOs**…"* ***[Advanced senior psychiatric nurse]*** *"Too much is now left to NGOs where they are now seeing these children…"* ***[Advanced senior psychiatric nurse]***
Poor implementation of early detection and preventive policies	Preventative approaches not implemented	*"…preventative approaches … that's not being implemented…"* ***[Advanced senior psychiatric nurse]*** *"There's no early detection and prevention for CAMH services … we only get them once it's a train smash and there's a lot of services that we need…"* ***[Child and adolescent psychiatrist]***
Overall neglect of CAMH services	Poor knowledge of the needs of CAMH services	*"There's lack of understanding of child and adolescent mental health, it's still termed naughtiness even with educational services…"* ***[Advanced senior psychiatric nurse]*** *"…it's very difficult to put a voice to those people who don't know what we do, versus what they do … they don't understand what the need is this side…"* ***[Nursing manager]***
	Lack of priority for CAMH services	*…a psychiatric emergency versus medical emergency … there's not so much recognition … like a patient in ICU…"* ***[Advanced senior psychiatric nurse]*** *"They don't see a psychiatric emergency like a medical emergency … less urgent…"* ***[Advanced senior psychiatric nurse]*** *"A psychiatry emergency is always less important than a medical emergency…"* ***[Advanced senior psychiatric nurse]***
	Low levels of advocacy for CAMH services	*"…we haven't got the bodies to do the advocacy…"* ***[Child and adolescent psychiatrist]*** *"In the actual fact there's lots of advocacy but it's been busy with Esidimeni…"**** ***[Child and adolescent psychiatrist]***

*A local term used to refer to the workload expectation in services i.e., the requirement to see a certain number of patients per day in a service.

**Non-governmental organizations.

***Referring to the Life Esidimeni Crisis (2018) when 118 adults with mental health disorders and/or intellectual disability died after transfer from specialist facilities to non-registered NGOs.

Non-governmental/non-profit organizations (NGO/NPOs) and academic institutions were seen as providing good support to the overburdened DoH CAMH services. Academic institutions were recognized not only as conducting research and teaching, but also as providers of clinical services to children and their families. NGO/NPOs were recognized as providing services for a lot of cases that could not be seen in the DoH CAMH services. However, participants expressed the view that the NGO/NPO sector was "overused" as a way of compensating for the lack of government-funded CAMH services.

Poor Implementation of Early Detection and Preventive Policies

Despite the reported strength of the presence of preventive service plans, concern was expressed that these policies and plans had not been implemented. Early detection of CAMH problems was lacking, cases were often described as being referred only when there is a crisis or when the problem has worsened and become complicated by which time complex, long-term, and multiple resources are typically required for intervention. Participants reported that the preventive work becomes the burden of the parents and families who are expected to take initiative to ensure care for their children.

Overall Neglect of Child and Adolescent Mental Health Services

Participants reported that the needs for CAMH services were not prioritized and often not met in comparison with other medical disciplines, particularly for emergencies. Given that CAMH services are dependent on budget allocation within facilities, CAMH specialists in those facilities often have to advocate for the needs of CAMH services. However, these attempts were described as "often in vain" due to limited insight of those in managerial positions, of non-specialists, and those who allocate budgets. Participants expressed concern about a lack of insight and understanding about what CAMH services entail and about exact needs of CAMH services, in spite of ongoing information, advocacy, and education within facilities and institutions.

Participants acknowledged that advocacy for CAMH services at a high-level provincial and national level was actually lacking and that existing advocacy in mental health had mainly focused on the "Life Esidimeni" crisis (29) which solely focused on the mental health needs of adults with and without intellectual disability. The "Life Esidimeni" crisis involved the death of 118 adults with mental health problems and/or intellectual disability in 2018 when they were forcibly removed from "Life Esidimeni" psychiatric homes and placed in ill-equipped, unprepared, and unlicensed NGOs.

Opportunities

The following were identified by participants as opportunities for development and strengthening of CAMH services in the Western Cape: collaborative working between CAMH and pediatric services, and increased provincial Government (DoH) involvement. **Table 3** provides a summary of the identified themes and subthemes illustrated with representative quotes from participant transcripts.

Collaborative Working Between Child and Adolescent Mental Health and Pediatric Services

The "first 1,000 days" project, a collaborative cross-agency program involving the DoH, WCED, and DSD (30), was created as a systematic preventative program to identify and reduce risk factors for maternal and infant mental health problems in the first 1,000 days of life. The program was given as example of an approach that helped to establish and build relationships across agencies (DoH, WCED, and DSD) and between different disciplines, and led to reporting on health indicators in the first 1,000 days of life. It was seen as instrumental in creating awareness among pediatricians about maternal and infant mental health, which improved interaction and cross-referrals between CAMH and pediatrics services. The project was therefore identified as a model to improve integrated services across agencies and disciplines working with children and adolescents at risk of mental health problems.

TABLE 3 | A summary of themes illustrating the opportunities to improve child and adolescent mental health services.

Overaching theme	Sub-themes	Illustrative examples/quotes
Collaborative working between CAMH services and pediatric services	Early identification of CAMH problems	*"There was a proposed merger of pediatricians and child psychiatrists. The first 1000 days … the pediatricians are reporting on the first 1000 days … actually the first 1000 days is a facilitator…"* ***[Child and adolescent psychiatrist]***
Increased Provincial Government (Department of Health) involvement		*"There's now some support from the Department [Department of Health] for the last three years…"* ***[Child and adolescent psychiatrist]***

Increased Provincial Government (Department of Health) Involvement

Participants described that there had been increased interaction between the Provincial DoH and CAMH specialists over a 3-year period (2014–2017), with an interest from the Provincial DoH to understand CAMH services and service needs. This was seen as an opportunity for CAMH specialists to advocate for the needs of CAMH services.

Threats

The following threats for CAMH services in the province were identified: Silo working of agencies, societal stressors, inadequate infrastructure and other resources, and lack of dedicated funding for CAMH services. **Table 4** provides a summary of the identified themes and subthemes illustrated with representative quotes from participant transcripts.

Silo Working of Agencies

Participants described a lack of "joined-up" or coordinated multi-agency work between the DoH, WCED, and DSD. All these departments were described as work in "silos," which made it difficult to manage cases that required intervention or input from all three agencies. There was a strong feeling that the challenges and service pressures within WCED and DSD impacted directly on the DoH, leading to inappropriate referrals to the DoH and struggles to do joint working across agencies.

Societal Stressors

Participants cited the high rates of poverty, crime, substance abuse, and violence in communities as resulting in psychiatric morbidity in children and adolescents. This was perceived to lead to a "revolving door" system for children and adolescents affected with mental health problems. Stakeholders described that treating mental health problems effectively when children live in maladaptive contexts and unsupportive communities becomes difficult to sustain. Many children were described as coming from traumatized backgrounds and fractured family structures. Parents often have mental health problems and intervention is needed for both the parent and the child. Senior stakeholders also reported significant stigma attached to child and adolescent mental illness and an associated lack of insight into CAMH problems. Psychiatric problems in children were often viewed as a child just "being naughty" or as parents not being able to discipline their child. Families who seek help from CAMH services were often stigmatized within their extended families, in their communities, and within the healthcare system.

Inadequate Infrastructure and Other Resources

Participants reported that in the whole of the Western Cape there were only three CAMH specialist units providing inpatient and outpatient services exclusively for children and adolescents. These units provide tertiary services and are therefore based only at the two tertiary teaching hospitals in Cape Town. The limited

TABLE 4 | Provides a summary of themes illustrating the threats for child and adolescent mental health (CAMH) services.

Overaching theme	Sub-themes	Illustrative examples
Silo working of agencies	Lack of multisectoral collaboration	*"The department of social development and the Western Cape education are the two biggest headaches … if they don't know which way [to refer patients] it becomes health's problem, and inevitably because it's not physical health it ends up in mental health … they are overburdened … they are flooded…"* ***[Advanced senior psychiatric nurse]*** *"lack of multiagency joint working. We're very much dependent on … social workers and the department of education and when those aren't functioning, that impacts on our work…"* ***[Senior clinical psychologist]***
Societal stressors	Societal decay	*"Societal decay is affecting us [CAMH services] …"* ***[Advanced senior psychiatric nurse]*** *"Lack of structure … fractured families … lack of stability…"* ***[Advanced senior psychiatric nurse]***
	Fractured families	*"…We come from a system which has been traumatised over generation with both systematic violence like group segregation … migrant labour … the political situation in the country has facilitated the breakup of families … so the parenting has been done by grandparents … which were under-resourced … it was just the system that was trying to produce the generation with difficulties … we're sitting with a generational legacy which has not been addressed … trying to address the child's problem in the context of weak parenthood…"* ***[Child and adolescent psychiatrist]***
	Stigma	*"With children there's always stigma. They cannot defend themselves. That can be a barrier…"* ***[Child and adolescent psychiatrist]***
Inadequate infrastructure and other resources	Limited dedicated CAMH therapeutic facilities	*"The children now are being lost … there are a lot of children with psychosis … we've lost therapeutic services for children…"* ***[Policymaker]*** *"There are no emergency psychiatric beds for children in this province, when TLC is full…"** ***[Advanced senior psychiatric nurse]*** *"There's no inpatient facilities for non-psychotic children…"* ***[Child and adolescent psychiatrist]***
Lack of dedicated finding for CAMH services	No separate funding for CAMH services	*"we have a competition with more sexy … you know once we lost out to the penis transplant**…it's always about ICU***, and the neurosurgeries and the and the penis transplants and all the other stuff…"* ***[Child and adolescent psychiatrist]*** *"CAMH services always have to compete with other departments for funding…"* ***[Child and adolescent psychiatrist]*** *"There is no separate funding for CAMH services…"* ***[Policymaker]***

**Therapeutic Learning Centre, a small inpatient unit for children with complex mental health problems.*
***Innovative surgery performed for the first time in South Africa.*
****Intensive care unit for physically ill children.*

services and infrastructure was described not only as a weakness as described above, but also as a threat to future services and service delivery.

Participants expressed concern that there were no dedicated CAMH services at primary level (public health services at community level). Children and adolescents are seen together with adult psychiatric patients in outpatient psychiatric services that are not child/adolescent-friendly. Children and adolescents may therefore be traumatized by the aggressive or high-risk behaviors of adult patients with serious mental illnesses. At day hospitals psychotropic medications are inconsistently available (e.g., available for a few weeks, and then not available for the next month). This may risk worsening of the mental states of children and adolescents and/or development of treatment resistance. As outlined earlier, resources were most limited in the most needy and vulnerable communities such as in very low socio-economic or rural settings.

At secondary (district/regional) level, there are no dedicated facilities for CAMH problems—neither for outpatient care nor for psychiatric emergencies. Acute cases of children under the age of 12 years therefore have to be admitted to general pediatric wards, and adolescents over 13 years of age have to be admitted to adult psychiatric emergency inpatient units. These inpatient units are not child/adolescent-friendly and do not have the appropriate resources to assess children and adolescents. Often there are no therapeutic resources, such as developmentally appropriate reading or self-help guides or play materials to engage children and adolescents while in the unit. Units are also not designed to provide safety and privacy to a child/adolescent with an acute psychiatric problem. Service providers are not trained to manage the challenging behavior of the acutely mentally ill child or adolescent. Even more pronounced than in outpatient settings, adolescents are frequency exposed to aggressive and high-risk behaviors of adults with acute severe mental illnesses.

Lack of Dedicated Funding for Child and Adolescent Mental Health Services

There were no dedicated budgets for CAMH services at National or Provincial level. Participants reported that, at some stage in the past, provincial budgets were divided into mental health and general health budget and the mental health budget was dedicated and ring-fenced. The ring-fenced mental health budget was, however, discontinued and only mental hospitals now have dedicated budgets. CAMH is a predominantly outpatient-based service and there are no dedicated CAMH hospitals. The budget for CAMH services are therefore integrated within the general health budget within the facilities where CAMH teams are based, for instance at Tygerberg, Lentegeur, or Red Cross War Memorial Children's Hospital. Participants expressed the view that there was high competition with other departments and emergencies for budget in these facilities, and that CAMH services were often the least valued and prioritized, making it difficult to maintain essential resources or to improve the existing resources.

DISCUSSION

Noting the lack of improvement in CAMH services in South Africa over the years since the last situational analysis in 2005 (11), and the lack of progress in policy development and implementation (11, 19), we sought to obtain senior stakeholder perspectives on the current state of CAMH services to provide key local knowledge that could inform policy and service strengthening for CAMH in a South African context. The study therefore collected multistakeholder data from CAMH policy-makers, senior service managers, and senior service providers on the SWOT of CAMH services in the Western Cape Province of South Africa.

Stakeholders identified a number of positive aspects of CAMH services. These included recent improvements in services, strong specialist services at tertiary level, improved collaborative working with the provincial DoH government, and enhanced interaction between the specialist multidisciplinary teams and non-specialist colleagues at district and community level. These findings suggest potential strategies for CAMH service strengthening through ongoing collaboration with policymakers and funders, and ongoing training and capacity-building with district and community-level colleagues. Results may suggest that particular benefits may come from the identification of appropriate task-sharing activities in keeping with WHO recommendations (31).

The stakeholder findings also identified a significant number of negative aspects of CAMH services, many of which were similar to observations made more than 10 years earlier (11). Poor intersectorial working, limited and inappropriate resources, unreasonable expectations of CAMH staff, and absence of dedicated budgets for CAMH, all in the context of societal stressors, were seen as major barriers to CAMH services. Current proposals on budget allocation, the structuring of CAMH services and allocation of resources for CAMH services are therefore likely to threaten development of comprehensive CAMH services and compromise the efficacy of CAMH providers at all levels of care very significantly over the next decade. This, in turn, may result in greater costs to treat complicated CAMH problems in adulthood (12, 32).

In an attempt to generate a synthesis of the findings from this SWOT analysis, we sought a visual model that could help to integrate the otherwise potentially unrelated positive aspects outlined (strengths and opportunities) in relation to the negative aspects outlined (weaknesses and threats). Using the concept of

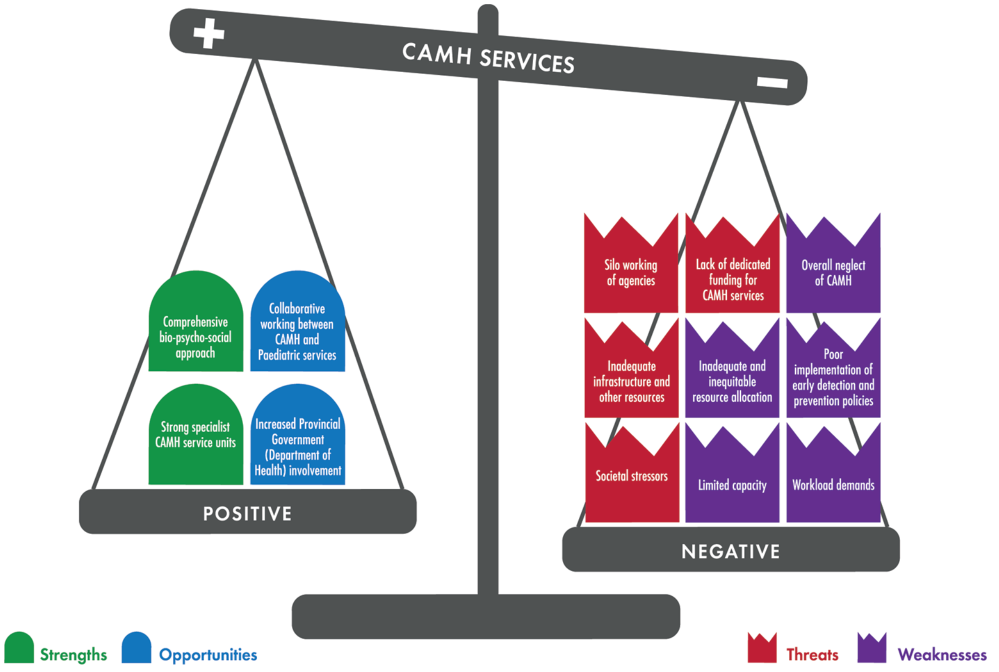

FIGURE 3 | The tipping point model of child and adolescent mental health services.

"tipping points" in the context of our study, we propose that the strengths and opportunities *versus* the weaknesses and threats may contribute to a scale of potential for strengthening (or weakening) of CAMH services. **Figure 3** provides a graphic representation of this concept, incorporating the findings from this study. Data generated in this study suggests that, even though a number of positive elements were identified, a much larger number of negative elements of CAMH services may be present, threatening a tipping point toward disruption and weakening of services.

While these findings are of significant concern, particularly in a country which is often thought of as well-developed in terms of mental health and health services, the "tipping point model" of CAMH service strengthening may also allow us to identify small events, actions, and activities that could lead to significant positive change. From the data presented here, it seems that, for instance, the "first 1,000 days of life" project (which was a multi-sectorial project to identify and manage risks to mothers and their infants), and recent collaborative work between CAMH teams and Provincial DoH (to identify and strengthen some elements of CAMH services) may represent examples of positive tipping events. These can facilitate recognition of CAMH as a health priority and provide an opportunity for changing budget allocations to create parity with other medical problem. Such interactions may also influence policies that could formally define interactions, roles, and responsibilities between the four Government Departments directly involved in children and adolescents (DoH, WCED, DSD, and Justice).

It is clear that there are many unanswered questions about CAMH in the Western Cape and in South Africa that could shed light on potential positive tipping events for CAMH strengthening. For instance, the perspectives and lived experience of clinicians at the very grassroots of district and community service delivery, and those of families and children who access CAMH services may identify additional positive or negative tipping factors. It would be of particular importance to seek broad representation across socio-economic, cultural, linguistic, rural/urban, religious, and age-based variables.

Limitations of the Study

We acknowledge that the data generated in this multistakeholder analysis were derived from one small group of high-level clinical, managerial, and policy-making stakeholders in one South African province. Great care should therefore be taken in generalization of findings. However, given that this was a qualitative study, the data were sufficient to generate saturated themes, supporting the robustness of findings. At least some of the themes and subthemes that emerged may, therefore, resonate with the needs of other provinces and LMICs. We further acknowledge that the study performed qualitative analysis of data which may be open to bias. However, to increase trustworthiness and robustness of findings, we used two independent raters (one a CAMH specialist, the other a non-clinician) to generate themes and subthemes. Member-checking during the workshop further added to the trustworthiness of results. It will be important to perform triangulation of data with subsequent studies (e.g., provider or user perspectives) to generate the most comprehensive findings. All discussions were held in English, even though not all participants were primary English speakers. However, as outlined in the *Material and Methods*, English is very much the "lingua franca" in professional settings, and all participants indicated that they were fluent in English. We were therefore confident that the quality of data was not compromised as a result of conducting the workshop in English. It would be important for "grassroots" level analysis to interview participants in their primary language, such as isiXhosa or Afrikaans. The absence of other service providers and of children and families in this manuscript may appear to be a limitation. However, given the importance of the user/carer perspective and the provider perspective (as shown in **Figure 1**), we have opted to dedicate two separate sub-studies and separate manuscripts to the voices of families and children who use CAMH services, and to those who provide services at the grassroots.

Relevance of Findings to Other Low- and Middle-Income Countries

As outlined under limitations, we acknowledge that themes and subthemes identified may not all be of direct relevance to other LMICs. In fact, it is important to consider that different countries, communities, and settings may have very different CAMH service models and healthcare systems. It would therefore be of utmost importance to perform similar SWOT analysis in different settings that may identify similar or different "tipping" events or factors that could be used for CAMH strengthening activities in those settings. We predict that there may be some universal themes, subthemes, and "tipping points" across LMICs such as lack of policy development, inadequate CAMH resources, poor intersectoral collaboration, unclear financing for CAMH services, and the potential integration of CAMH services into general health services (12, 33). However, these should all be subject to empirical investigation.

CONCLUSIONS

Findings of this SWOT analysis provided insight into senior stakeholder perceptions about the current state of CAMH services in the Western Cape province of South Africa. The weaknesses and threats to CAMH services identified here were clearly of concern. We propose, as a next step, that further exploration of clinician and user perspectives from the grassroots of CAMH services should be investigated to identify positive "tipping" events, activities, or behaviours that could be incorporated into a comprehensive strategy to strengthen CAMH services in South Africa, and that may be of potential value in other LMICs.

DATA AVAILABILITY STATEMENT

Data generated in this study are available from the authors with appropriate permissions.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the University of Cape Town and Faculty of

Health Sciences Human Research Ethics Committee with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee (HREC 188/2016). Information sheets containing details about the study and consent forms were emailed to participants prior to a face-to-face workshop held in March 2017. All consent forms were collected on the day of the workshop.

AUTHOR CONTRIBUTIONS

SM, PV, and MS participated in the conception and design of the study. SM performed data collection. SM and KJ performed the data analysis and interpretation of the data and prepared the first draft of the manuscript. PV and MS contributed to analysis, interpretation of results, and writing of the manuscript. All authors participated in the reviewing of the content for submission. All authors approved the final version of the manuscript.

FUNDING

To SM: Research Funding—Department of Psychiatry, University of Cape Town; Spirit of 68 Scholarships—University of Cape Town; The Western Cape Department of Health; SAMRC Research Development Grant. To PV: National Research Foundation, University of Cape Town, Struengmann Fund.

ACKNOWLEDGMENTS

We are extremely grateful to all participants for their valuable insights, contributions and passion for child and adolescent mental health services in South Africa.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers
in Psychiatry

ORIGINAL RESEARCH
published: 17 December 2019
doi: 10.3389/fpsyt.2019.00860

Lay Counselor Perspectives of Providing a Child-Focused Mental Health Intervention for Children: Task-Shifting in the Education and Health Sectors in Kenya

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Specialty section:
This article was submitted to
Public Mental Health,
a section of the journal
Frontiers in Psychiatry

Received: 11 June 2019
Accepted: 01 November 2019
Published: 17 December 2019

Citation:
Dorsey S, Meza RD, Martin P,
Gray CL, Triplett NS, Soi C,
Woodard GS, Lucid L, Amanya C,
Wasonga A and Whetten K (2019)
Lay Counselor Perspectives of
Providing a Child-Focused Mental
Health Intervention for Children:
Task-Shifting in the Education
and Health Sectors in Kenya.
Front. Psychiatry 10:0860.
doi: 10.3389/fpsyt.2019.00860

The global mental health treatment gap has increasingly been addressed using task-shifting; however, very little research has focused on lay counselors' perspectives on the acceptability, feasibility, and appropriateness of mental health interventions in specific government-supported sectors that might scale up and sustain mental health care for children and adolescents. In western Kenya, these sectors include Education and Health. Data come from a large hybrid effectiveness-implementation study examining implementation practices and policies in either or both sectors that support successful implementation of a child-focused intervention, Trauma-focused Cognitive Behavioral Therapy (TF-CBT), for children and adolescents who had experienced parental death. We examined lay counselors' self-report of acceptability, feasibility, and appropriateness of TF-CBT. Lay counselors were teachers (n = 30) from the Education sector and Community Health Volunteers (CHVs; n = 30) from the Health sector, who were part of Sequence 1 of a large stepped-wedge, cluster randomized trial. Lay counselor self-report surveys included reflective and formative measurement of acceptability, feasibility, and appropriateness administered after lay counselors in both sectors had experience delivering the locally-adapted, group-based TF-CBT intervention. Descriptive statistics (means, standard deviations) were used to understand counselors' perspectives stratified by sector. Both teachers and CHVs endorsed high acceptability, feasibility, and appropriateness of TF-CBT, with lay counselors' responses on items from the formative measures providing some insight into specific aspects of acceptability, feasibility, and appropriateness that may be important to consider when planning for implementation support. These early findings suggest that both sectors may hold promise for task-shifting of mental health care for children and adolescents but also underline the importance of considering the multiple facets of these three implementation outcomes as well as lay counselor context (Education vs. Health).

Keywords: global mental health, implementation science, task-shifting, acceptability, appropriateness, feasibility, evidence-based treatment

INTRODUCTION

Mental health disorders have increasingly become recognized as a prominent cause of global morbidity, with a significant portion of the world's population—450 million people—affected (1). In a recent reassessment of global burden of disease, mental illness accounted for 32.4% of years lost to disability (YLDs) and ranked on par with cardiovascular and circulatory diseases, each responsible for 13% of disability-adjusted-life-years (2). Children, adolescents, and young adults 5 to 24 years of age bear a high burden of mental illness. It is the leading cause of YLDs for this age group (3) and 75% of mental disorders commence during this period of life (4). Poverty is associated with increased susceptibility to mental illness, so consequently low- and middle-income countries (LMICs) are disproportionately affected (5). While services are improving, substantial gaps remain. The treatment gap is as high as 78% for adults (6) and even greater for children, with a median of only 0.16 of children in LMICs with mental health illness receiving any treatment (7). Services target mainly adults and severe mental illness, resulting in children being overwhelmingly neglected. Only 12% of outpatient and 6% of all other types of mental health facilities serve children (8). Most LMICs allocate 1-2% of the government's health budget to mental health services, which translates to less than $0.25 per year per capita (9). The funding gaps are correspondingly accompanied by shortage in human resources, as demonstrated by the relatively low mental health staff ratio of 1 per 100,000 population compared to more than 50 staff per 100,000 population in high-income countries (HICs; 10).

Given limited funding for mental health, and particularly children's mental health, sustainable services likely need to leverage existing systems and require few new resources (11). Task-shifting, a process in which non-specialists with little to no prior training or experience provide treatment under supervision (12), is recommended as a strategy to address mental health workforce gaps. A growing body of evidence documents the effectiveness of task-shifted mental health services across a range of LMICs and diverse cultural contexts (e.g. 13–17). A 2013 Cochrane review concluded that lay counselors have the potential to improve outcomes for depression or posttraumatic stress disorder (PTSD), but more research is needed, especially in regards to child treatment by lay counselors (18). In another systematic review focused specifically on the acceptability and feasibility of task-shifting among service users and healthcare practitioners (19), insufficient resources was identified as a primary barrier. Task-shifting strategies that leverage existing government-supported systems and require few new resources are necessary in resource-constrained settings. For children and adolescents, these systems include Education and Health, with delivery by individuals [e.g., teachers; community health volunteers (CHVs)] already part of these systems. However, little is known about these individuals' perspectives on delivering mental health treatment in their systems. Understanding lay counselors perspectives and experiences delivering mental health care in their systems is important so that we can understand potential for scale up and sustainment as well as any needed supports for scale up and sustainment.

The overall goal of this paper is to examine intervention acceptability, feasibility, and appropriateness among the first lay counselors who delivered a trauma-focused mental health intervention for children and adolescents in two distinct sectors in western Kenya. For the purpose of this paper, we use Proctor and colleagues' (20) definitions of the constructs of interest: Acceptability is conceptualized as the perception among stakeholders that an intervention is agreeable or satisfactory. Lack of intervention acceptability is a well-established barrier to implementation (21). Feasibility is the extent to which an intervention can be successfully carried out within a given context. Appropriateness is defined as the perceived relevance or compatibility of an intervention to a given setting and problem. While these constructs are related, each is conceptually distinct and may have different implications for implementation. For example, an intervention could have high appropriateness but low feasibility in a low-resource setting.

The global mental health literature includes only a few empirical studies of lay counselor perspectives on acceptability, feasibility, and/or appropriateness of delivering mental health interventions. At the time of the review by Padmanathan and De Silva (19), they identified only one study that examined lay counselor perspectives on intervention delivery, conducted by Jordans and colleagues. The authors found that 5–47% (varied by country) of counselors (N = 694) in a multilayered psychosocial intervention for children in areas of conflict in Burundi, Sudan, Sri Lanka, and Indonesia experienced distress when delivering the intervention (22). Lay counselors at different levels of the intervention received different training and supervision support; the least distress was endorsed by the group that received the most training and support. Since Padmanathan and De Silva's 2013 review, research in this area has increased, but there are still gaps in our knowledge. For example, in a 2014 qualitative study of Zambian lay counselors' experience providing Trauma-focused Cognitive Behavioral Therapy (TF-CBT; 23) (N = 19), counselors drawn from a wide variety of settings described experiences consistent with high perceived acceptability (e.g., liking TF-CBT; seeing positive impacts on children and families); however, counselors also reported challenges, including treatment duration and poor attendance (24, 25). Post-training practice and supervision groups were noted as helpful and motivating. In a study focused specifically on the feasibility, acceptability, and effectiveness of a training for teachers on providing psychoeducation and facilitating access to mental health care in Haiti ($N = 22$; 26), both qualitative and quantitative data indicated the training was acceptable and feasible, though participants recommended extending the duration and number of training sessions.

Of the existing studies of lay counselors, few have been able to separately examine perspectives of lay counselors nested within specific government sectors and even fewer have focused on child and adolescent interventions. An additional limitation has been when and how constructs have been measured. Studies often have investigated these constructs only during what Aarons and colleagues (27) define as the exploration and preparation phases of implementation, and have not included an evaluation once counselors have actual experience delivering the intervention/s. Due to the limited availability of quantitative measures, most studies have used a qualitative approach to understanding counselor perspectives (e.g., 24). While qualitative approaches provide rich data about counselor experiences, they require intensive resources and time that some mental health implementation efforts may not have and may limit comparison across studies. Only recently have quantitative scales been developed to assess these constructs (28, 29), with their use potentially allowing for expanded research in this area.

The goal of the present study is to assess counselor-perceived acceptability, feasibility, and appropriateness of a trauma-focused intervention for children and adolescents in the context of a task-shifting, implementation science-focused study in western Kenya. We specifically examine these constructs with the first lay counselors from two different sectors, Education and Health, who delivered TF-CBT (23) for children who experienced the death of one or both parents and have related mental health symptoms (30, 31). While these first lay counselors represent a sub-group of our final sample (60 of 240), given study design and randomization procedures, they likely are representative of counselors in the full sample. In addition, our sub-sample is larger than most other studies examining these constructs in lay counselors. Given limited global mental health research focused on implementation science outcomes and on children and adolescents, findings from this sub-group of 60 lay counselors are valuable.

We evaluate lay counselor perspectives after the counselors had sufficient experience implementing the intervention. Our measurement approach distinguishes two types of assessment that facilitate a deeper understanding of the constructs of acceptability, feasibility, and appropriateness. For acceptability and feasibility, we use combined reflective measurement—where covariation in items reflects variation in some underlying construct—and formative measurement—where variation in items is thought to cause a change in a construct (see 32 for a comprehensive review of reflective and formative measurement). For appropriateness, we use formative measurement at both the provider- and organizational-level. A blended reflective-formative approach allows for understanding of both counselors' overall sense of these constructs, and specific experiences that provide insight into their perceptions. We explore differences between counselor perspectives across the two sectors, given differences in regard to counselor workload, resources, and role/embeddedness in their organizations.

METHOD

Building and Sustaining Interventions for Children (BASIC) Overview

Data for this study come from a large NIMH-funded hybrid effectiveness-implementation study of TF-CBT delivered through both the Education (via teachers) and Health (via CHVs) sectors in Western Kenya: Building and Sustaining Interventions for Children (BASIC; NIMH-funded R01MH112633) conducted as a collaboration between Duke University, the University of Washington, and Ace Africa, in Bungoma, Kenya (33). This study builds on a pilot of TF-CBT in East Africa (31) and a large randomized controlled trial (RCT) in Kenya and Tanzania (30) that demonstrate the effectiveness of lay counselor-delivered TF-CBT in Kenya. The goal of BASIC is to learn what makes an enabling context for mental health delivery in both Education and Health, by identifying implementation practices and policies (IPPs) that support successful implementation in the distinct sectors. The study is a stepped wedge cluster randomized trial (SW-CRT) that includes seven sequences (i.e., sites that initiate the intervention in the same time period). Per best practice for SW-CRT reporting (34) we use SW-CRT CONSORT language here, to describe the design. In Kanduyi Constituency, there are 137 primary schools, each with an active health extension program in the surrounding community. We randomly selected and ordered 40 primary schools and their surrounding 40 communities (i.e., 40 "village clusters") into seven sequences, which initiate delivery of the TF-CBT intervention at different time points over the 5-year study. The first sequence, which is the focus of this study, included 10 village clusters (10 schools and 10 communities). Sequences 2–7 each have five village clusters. The first sequence involved more village clusters (10 vs. 5) so that findings from TF-CBT implementation in these schools and communities could inform implementation in subsequent sites.

The Ministries of Education and Health are involved in BASIC, provide stakeholder input and permission to schools, teachers, and CHVs to participate, and receive updates from schools, communities, and Ace Africa so that they can monitor progress. Village leaders are also involved, with CHVs sensitizing chiefs and village elders about the intervention so that they can encourage children and families to participate and reduce any perceived stigma. BASIC has three aims. Aim 1 involves identifying locally feasible and effective IPPs from the first 10 schools and 10 communities that implemented TF-CBT. These findings, from the first 25% of the sample, were used to develop implementation support for subsequent sites (i.e., the remaining 30 schools and 30 communities). Aim 2 of BASIC examines IPPs that predict adoption, fidelity, and sustainment in the full sample of 40 village clusters (40 schools and 40 communities). Aim 3 examines child clinical outcomes and implementation costs. The full BASIC sample will include 240 counselors (120 teachers, 120 CHVs) from 40 primary schools and 40 communities.

Procedures

Data for this study come from counselor self-report surveys from the first 10 village clusters randomly assigned to Sequence 1 in BASIC. Teacher and CHV counselors were trained in TF-CBT in January 2018 (see *Lay Counselor Training* below). They delivered two sequential TF-CBT groups (one focused on girls, one focused on boys) during Term 1 and Term 2 of the academic year. Counselors participated in self-report surveys that assessed their demographic characteristics and experience prior to training. They also completed self-report surveys assessing their beliefs and perceptions about TF-CBT immediately post-training and after implementing the two TF-CBT groups (i.e., post-implementation). This study uses the latter, post-implementation counselor self-report measures of acceptability, feasibility and appropriateness as we believed their ratings would be more informed after gaining experience delivering TF-CBT. This data was collected between July and August 2018. The teacher counselor surveys were administered in English, whereas CHV counselor surveys were administered in Kiswahili to accommodate language preferences. All procedures were approved by the Institutional Review Boards (IRBs) at Duke University and the Kenya Medical Research Institute.

TABLE 1 | Characteristics of Teacher Counselors and Community Health Volunteers (CHVs) Counselors from 10 clusters in the trial.

Characteristic	Teachers (*N* = 30)		CHVs (*N* = 30)	
	N	**%**	***N***	**%**
Gender				
Female	21	70%	21	70%
Male	9	30%	9	70%
Highest Level of Education				
None	0	0%	0	0%
Primary education	0	0%	7	23%
Secondary education	2	7%	22	73%
Certificate	17	57%	1	3%
Diploma Certificate	3	10%	0	0%
University Degree	0	0%	0	0%
Master's Degree	8	27%	0	0%
Received any prior training in psychosocial counseling				
Yes	16	53%	18	60%
No	14	47%	12	40%
	Mean	**SD**	**Mean**	**SD**
Age in Years	42.8	7.7	44.5	9.5
Years as a Teacher or CHV	17.8	9.3	7.4	4.4
Years in the school or community where you currently work or volunteer	9.1	8.3	7.7	4.7

CHV, Community Health Volunteer; SD, Standard Deviation.

Participants

Participants were 60 lay counselors (30 teachers; 30 CHVs) from the first 10 schools and 10 communities who delivered TF-CBT as part of BASIC. Three counselors were selected for each site, as counselors worked in a group of three to deliver the intervention; two counselors led the child group and one counselor led the guardian group. Ace Africa worked with Head Teachers in each of the selected schools to identify teachers who would be appropriate for delivering TF-CBT. Ace Africa also worked with Community Health Extension Workers to identify CHVs from their health facility who worked as part of health extension in the communities surrounding the schools. Leaders were asked to nominate three individuals who were good with children, may have had some counseling experience (but not required), have time to deliver the program each week, and who have no immediate plans for leaving their school/area (e.g., ideally in the same school or village for two years). Demographic and background characteristics are presented in **Table 1**. Teachers and CHVs received an incentive of 500 Kenyan Shillings, approximately 5 USD, for each interview.

Intervention

TF-CBT is an evidence-based treatment protocol which treats psychosocial sequelae from child trauma exposure, with a specific application for maladaptive grief (23). There is substantial evidence of its effectiveness from RCTs in high-income countries (HICs; 35) with evidence of effectiveness from large RCTs in Zambia (15) and Kenya (30) and two small RCTs in the Democratic Republic of Congo (36, 37). In our previous collaborative work, we modified TF-CBT for delivery in Eastern Africa, with results from an open trial in Tanzania suggesting that the intervention held promise, given positive clinical outcomes at the end of treatment and maintained gains at a 1-year follow up (31). The modified TF-CBT, called *Pamoja Tunaweza* (Together We Can) involved 12 weeks of weekly group sessions and 3–4 individual sessions. Group-based delivery was chosen for multiple reasons: a) all youth were receiving treatment for the same primary traumatic event (parental death); b) the group format maximized reach and efficiency (i.e., more children served); and c) early qualitative work suggested that a group-based intervention was perceived as more culturally appropriate, more supportive, and less stigmatizing. Following the open trial, we conducted a large RCT in eastern Tanzania and western Kenya ($N = 640$), testing *Pamoja Tunaweza* compared to usual care services at end of treatment and a 1-year follow-up (30). The intervention was delivered by six lay counselors in each country, who were trained and supervised by the experienced lay counselors from the open trial in Tanzania, with support from the first author, following the Apprenticeship Model of training (38).

In BASIC, *Pamoja Tunaweza* included eight group-based sessions (reduced from 12) and two to three individual sessions (39). This abbreviated intervention was piloted with children assigned to usual care, after their 1-year follow up. All groups were delivered at the local schools, which are community owned. Children and guardian groups met concurrently with conjoint activities included in the final four sessions. Each session included practicing new skills at home. Initial group sessions (1–2) focused on psychoeducation about the *Pamoja Tunaweza* program, grief and loss, and on building coping skills. Guardians learned the same information both to reinforce lessons at home and to apply lessons in their own lives. Guardians also learned non-physical skills for managing behavior problems. The individual sessions, provided in-between group sessions 3–5, focused on imaginal exposure/trauma narrative (TN) work. Each child met individually with a counselor from the child group to talk about the parent(s)' death and surrounding events (e.g., getting sick, funeral). The counselor then met individually with the guardian to prepare them to provide emotional support when the child shared their TN. Group sessions 4–5 involved developing individualized plans for situational exposure (i.e., facing trauma reminders [pictures of the parent/s who died]), supporting TN work, processing trauma-related cognitions, and a group session in which each child individually and privately shared their TN with their guardian (with counselors providing support). The final group sessions (6–8) focused on grief-specific activities (e.g., converting the relationship from interaction to memory).

Lay Counselor Training

Teachers and CHVs participated in separate, 6-day, *Pamoja Tunaweza*/TF-CBT trainings. Training and supervision were provided by experienced, local Kenyan *Pamoja Tunaweza*/TF-CBT lay counselors from the large RCT, hereafter referred to as the local trainers who worked for Ace Africa. Training involved didactic instruction, manual review, trainer modeling of group sessions, time for questions, and trainee practice of group sessions in small groups, with peer and trainer feedback. For approximately 2–3 weeks following the training, teachers and CHVs practiced delivering *Pamoja Tunaweza*/TF-CBT groups with their co-counselors, with support and supervision from the local trainers.

Implementation, Supervision, and Fidelity Monitoring

Following practice, teachers and CHVs began delivering *Pamoja Tunaweza*/TF-CBT to children. In brief, children enrolled were those attending the local school in the village cluster, who had experienced the death of one or both parents (and other types of traumatic events), and had either posttraumatic stress symptoms or prolonged grief, determined by mental health assessment tools with locally defined cutoffs from prior research in the region (see 33). All counselors received ongoing, weekly supervision throughout the implementation period. Supervision involved in-person meetings and/or phone calls and SMS interactions *via* Whats App between the local trainers and counselors. Supervision typically included role play and practice by counselors of upcoming *Pamoja Tunaweza*/TF-CBT sessions, with supervisor feedback. When supervision was not in person, supervisors often listened to a role play *via* phone or reviewed an uploaded audio or video role play. Supervisors regularly observed group sessions to monitor fidelity, with a goal of observing 50% of sessions, and completed fidelity ratings for both adherence and competence, two important dimensions of fidelity (40). Counselors completed brief reports of fidelity and individual child/guardian treatment response (e.g., engagement in session or home practice; emotional state in groups) for each session. Supervisors' group observation and review of counselor reports informed supervision.

Measures

Measurement Approach

We employ a blended reflective-formative approach to measurement of our constructs of interest. Reflective measures follow a principal factor latent variable model—covariation among measures is caused by, and therefore reflects, variation in some underlying latent factor or construct (32). Formative measures follow a composite latent variable model, in which changes in the items are hypothesized to cause changes in the underlying construct. Unlike reflective measures, formative measures do not assume all items reflect a single underlying construct or factor. Rather, they assume that each item has an impact on a construct (32). Because of the nature of reflective measures, the mean score is thought to reflect the underlying constructs. However, reflective scales do not offer any indication of *why* they were rated as they were; thus, formative measures may complement reflective measures to provide depth or context regarding the construct being measured. We use Weiner and colleagues' (29) reflective measures to assess intervention acceptability and feasibility. We include items from the counselor-level version of the Johns Hopkins University (JHU) Implementation Measure (28), developed specifically for assessing implementation constructs in LMICs, as formative measures, providing more depth and contextual understanding. We also created some new items to assess aspects of feasibility and appropriateness that were not covered by the JHU measures. The reflective measures ask similar questions about the intervention's acceptability and feasibility (e.g., "*Pamoja Tunaweza*/TF-CBT met my approval" and "*Pamoja Tunaweza*/TF-CBT was appealing") as a means of assessing the respondent's perception of the underlying construct of acceptability or feasibility. The formative measures ask about specific elements of the intervention and surrounding context that contribute to its acceptability, feasibility and appropriateness. As such, lay counselors' responses to individual items in the formative measure provide insight into why they might have rated the reflective measure in the way that they did. Please see **Figure 1** for a graphic representation of reflective and formative measurement.

Selection and Adaptation of Reflective Measures

Weiner and colleagues' (29) newly developed measures assessing intervention acceptability, feasibility and appropriateness were designed using participants from HICs who were mental health professionals experienced in mental health service delivery. Given differences in our context, each of the three measures along with their construct definitions (20) were reviewed in English with supervisors trained in TF-CBT at Ace Africa. Items were translated into Kiswahili by a bilingual supervisor. Another

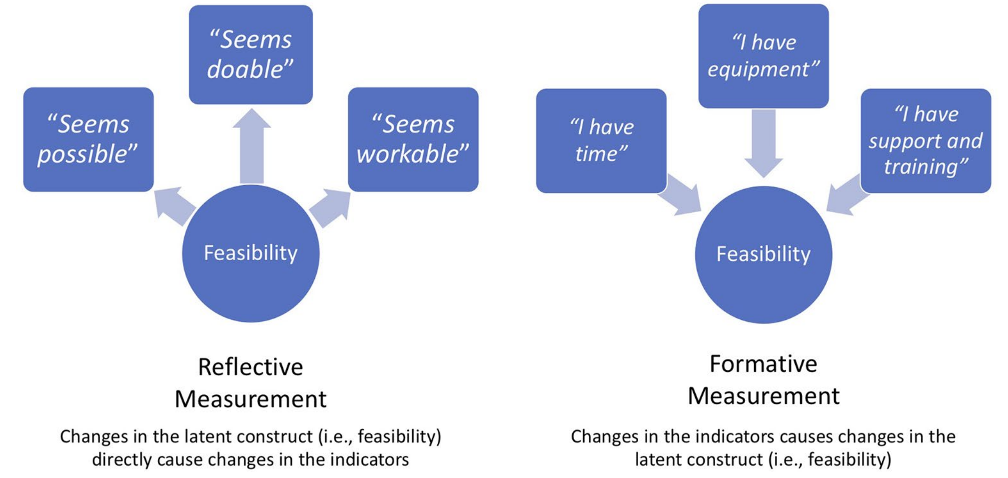

FIGURE 1 | Distinction between reflective and formative measurement models.

Ace Africa team member who had not seen the original English items back-translated the measure. For the Appropriateness measure, there were more perceived challenges for fit with a task-shifting context. Given the differences in provider types (professionals in HICs with experience delivering different types of mental health treatments vs. lay counselors in LMICs new to mental health treatment delivery of any treatment type), the Weiner (29) Intervention Appropriateness measure did not seem to capture the broader need to assess the appropriateness of the individual's role or setting for delivering the treatment. Therefore, only the Weiner (2017) Intervention Acceptability and Feasibility measures were used as reflective measures. Inter-item correlations (IICs) for each measure were examined; a minimum threshold of 0.20 was used to retain items (41).

Counselor Demographics and Background Characteristics

The questionnaire was administered prior to *Pamoja Tunaweza/*TF-CBT training and assessed counselor gender, age, education level, and previous training and experience providing psychosocial counseling.

Acceptability

Two measures were used to assess acceptability. The four-item reflective Acceptability of Intervention measure (29) was used to assess lay counselor perspectives of intervention acceptability. Weiner and colleagues' (29) reported acceptable internal consistency (α = 0.85) and test-retest reliability (r = 0.80). Internal consistency for the 4-item scale in our sample was 0.68 for teachers and 0.69 for CHVs. The IICs supported retaining all four items, with all above 0.20 at post-implementation.

The JHU Implementation Science scale for Acceptability was used as a formative measure of acceptability, including only the 5 items that mapped directly onto Proctor's definition of acceptability and did not conceptually overlap with items on the Acceptability of Intervention measure. A validity study of the consumer-level version (vs. counselor/provider-level) of the JHU Implementation Science scale found acceptable test-retest reliability (rho: 0.70) and support for criterion validity (28). While not used as a reflective measure in our study, the counselor-level measure had acceptable internal consistency reliabilities. Analysis of data from our sample suggest convergent validity between the Acceptability of Intervention measure and the individual 5-items on the JHU Implementation Science scale (range for teachers: *r*: 0.36 - 0.59; range for CHVs: *r*: 0.41 - 0.58). One of the five items from the formative scale assessed the acceptability of supervision (e.g., "I was satisfied with the supervision I received when I provided *Pamoja Tunaweza/TF-CBT*"), given the importance of this practice for high-fidelity TF-CBT delivery. Other example items included: 1) the extent to which the lay counselors felt positively about providing *Pamoja Tunaweza*/TF-CBT (e.g., "I felt good about providing *Pamoja Tunaweza*/TF-CBT") and 2) the extent to which they understood *Pamoja Tunaweza*/TF-CBT (e.g., "I felt that the components of *Pamoja Tunaweza*/TF-CBT made sense to me") (see **Table 2** for all items). All acceptability items from both the reflective and formative measures were assessed on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Feasibility

Two measures were used to assess feasibility. The 4-item reflective Feasibility of Intervention measure (29) was used to assess lay counselor perspectives of intervention feasibility. Weiner and colleagues' (29) reported acceptable internal consistency (α = 0.89) and test-retest reliability (r = 0.88). Internal consistency for the 4-item scale in our sample ranged from 0.70 to 0.92 depending on rater (teacher, CHV). The IICs from teacher surveys and all but two correlations from CHV surveys were above 0.20 at post-implementation. Potential translation issues may explain why two IICs were lower on the CHV surveys. Given the smaller sample size of 30 CHVs in Sequence 1, we decided to retain all four items at this time and re-run these analyses with the full sample after the data collection is complete to determine if any questions should be dropped from the CHV survey.

The JHU Implementation Science scale for Feasibility was used as a formative measure of feasibility. A validity study of the consumer-level version (vs. counselor/provider-level) of the JHU Implementation Science scale found acceptable test-retest reliability (rho: 0.76) and support for criterion validity (28). While not used as a reflective measure in our study, the counselor-level measure had acceptable internal consistency reliabilities. Analysis of data from our sample suggest convergent validity between the Feasibility of Intervention measure and the individual items on the JHU Implementation Science scale for CHVs (range for CHVs: *r*: 0.25 - 0.59). Among teacher respondents, the Feasibility of Intervention measure and 7 of the 10 items on the JHU Implementation Science scale suggest convergent validity (range for teachers: *r*: 0.21 - 0.60). Three items had no association ($r = 0.051 – 0.16$) and are noted in **Table 3**. We used 12 of the original 20 items across four domains related to feasibility of intervention delivery: 1) provider skills (e.g., "I believe I am sufficiently skilled at providing *Pamoja* Tunaweza/TF-CBT to orphans"), 2) time (e.g., "I have enough time for all the activities that go into providing *Pamoja Tunaweza*/TF-CBT"), 3) resources (e.g., "I have the right equipment [e.g., pens/pencils/chalk, paper, exercise books, slip charts, mark pens] to regularly provide *Pamoja Tunaweza*/TF-CBT"), and 4) personnel/supervision (e.g., "I am able to reach my *Pamoja Tunaweza*/TF-CBT supervisor when needed") (see **Table 3** for all items).

We selected items in each of the 4 domains to best capture the factors most likely to impact feasibility of delivering a group-based trauma intervention for children in these two contexts. For example, we omitted items about certain resources or forms of payment that were not relevant to our settings. Minor changes were also made to the wording of items to fit the local context. All feasibility items from both the reflective Weiner and formative JHU measures were assessed on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree).

In addition to these two measures, we also included two items assessing important aspects of feasibility. The first assessed intervention complexity specifically, given that intervention complexity is inversely related to feasibility ("*Pamoja Tunaweza*/TF-CBT is too complex to do in my school"). This item was measured on a five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). The second inquired about the estimated hours per week that respondents felt *Pamoja Tunaweza*/TF-CBT would require, given the importance of this information for understanding added workload and feasibility for providers in the two contexts ("On average, how many hours per week do you spend on *Pamoja Tunaweza*/TF-CBT [e.g., preparing for sessions, delivering sessions, and supervision]?").

Appropriateness

Only a formative measure was used to assess appropriateness. We adapted six items from the JHU implementation measures that aligned with Proctor and colleagues' (20) definition of appropriateness. Minor changes were made to the wording of items to fit the local context (e.g., changing general terms like "job description" to be specific to the counselors' context: "as part of my role as a teacher [or CHV]"). The validity study of the consumer-level JHU measure found acceptable test-retest reliability (rho: 0.79) and support for criterion validity (28). While not used as a reflective measure in our study, the counselor-level measure had acceptable internal consistency reliabilities. Two additional items were developed to measure appropriateness domain content for which JHU items did not exist. Given challenges in creating new items, we used Hujig's Theoretical Domains Framework when possible to guide item creation (42). In the resulting 8-item measure, four items assessed the perceived fit of delivering *Pamoja Tunaweza*/TF-CBT with one's role (e.g., "I believe that teachers/CHVs should be providing *Pamoja Tunaweza*/TF-CBT"). The additional four items assessed the perceived fit of delivering *Pamoja Tunaweza*/TF-CBT in the respective delivery setting (e.g., "*Pamoja Tunaweza*/TF-CBT fits with my [community (CHV) or school (teacher)]'s approach to helping orphaned children") (see **Table 4** for all items). All appropriateness items were assessed on a 5-point scale ranging from 1 (not at all appropriate) to 5 (extremely appropriate).

Analytic Approach

Given the sample size of 60 counselors, we followed best practices for small samples and did not conduct null hypothesis significance testing (43, 44). Rather, we used descriptive statistics to understand provider-level perceptions of key implementation measures following delivery of the *Pamoja Tunaweza*/TF-CBT intervention.

For the reflective measures (Intervention Measures for Acceptability and Feasibility; 29), we first averaged each counselor's scores of the individual items to create the composite score. Individual counselors' average scores are presented in box plots to provide visualization of overall variation within each site, by sector. We then calculated means (M) and standard deviations (SD) across all teachers and CHVs, respectively. We report means and SDs, as well as the range of scores using the minimum and maximum reported values of any of the items within the scale. Higher scores represent more favorable responses.

For the formative measures (JHU Implementation scales for acceptability and feasibility, additional created items for provider-level and organizational-level appropriateness), we calculated the means and standard deviations of the individual items. We also report the range for each item. As with the reflective measures, higher scores represent more favorable responses. The same method (mean, SD, range) was used for the additional item assessing complexity. Because complexity represents the inverse of feasibility, lower scores reflect more favorable responses for this item. For average number of hours per week, we calculated the mean, SD, and range.

All data were stratified by sector (teachers in Education; CHVs in health) to reflect perceptions of the intervention situated within the two different contexts. Given our study goal of describing counselor perspectives on TF-CBT in both sectors, we did not conduct statistical comparisons across sectors. Consistent with best practices when sample size is small, we did not conduct statistical comparisons across time points (post-training to post-implementation). All analyses were conducted using Stata 14 (45).

RESULTS

Counselor Demographics

Our sample included the 30 teachers and 30 CHVs who delivered *Pamoja Tunaweza*/TF-CBT in the first 10 village clusters (Step 1) of the BASIC trial (**Table 1**). Teacher counselors were mostly female (70%), held a certificate (57%) or a Master's degree (27%), and were on average 42.8 (SD = 7.7) years old. CHV counselors were mostly female (70%), had completed primary (23%) or secondary (73%) education, and were on average 44.5 (SD = 9.5) years old. More than half (53% of teachers and 60% of CHVs) reported receiving some prior psychosocial training although no counselors had prior experience with TF-CBT or other evidence-based interventions for child and adolescent mental health problems.

Acceptability

The reflective measure (29) indicated high perceived acceptability of the TF-CBT intervention after implementing two groups (post-implementation) for lay counselors in both the Education and Health sectors (**Figure 2** and **Table 2**). Mean acceptability was 4.67 (*SD* = 0.34) for teachers and 4.77 (*SD* = 0.31) for CHVs. Descriptive statistics for all items from the formative measure (28) are included in **Table 2**, separated by counselor type. Examining responses on specific items to understand aspects of acceptability, teachers and CHVs endorsed high agreement with "I felt good about providing *Pamoja Tunaweza*/TF-CBT" (*M* = 4.73, *SD* = 0.45; *M* = 4.83, *SD* = 0.38; respectively). All responses were in the 4 ("agree") to 5 ("strongly agree") range. Lay counselors also endorsed high agreement with "I felt that the components of *Pamoja Tunaweza*/TF-CBT made sense to me" (*M* = 4.73, *SD* = 0.52; *M* = 4.77, *SD* = 0.43, respectively), with responses in the 3 ("neither agree nor disagree") to 5 range for teachers and the 4–5 range for CHVs. Most teachers (*M* = 4.5, *SD* = 0.82; Range 1–5) and all CHVs (*M* = 4.7, *SD* = 0.47; Range 4–5) endorsed high agreement with "I was satisfied with the supervision I received when I provided *Pamoja Tunaweza*/TF-CBT."

Feasibility

The reflective measure (29) indicated high levels of perceived feasibility at post-implementation among teachers (*M* = 4.35, *SD* = 0.60) and CHVs (*M* = 4.67, *SD* = 0.40) (**Figure 3** and **Table 3**). Descriptive statistics for all items from the formative measure are included in **Table 3**, separated by counselor type. Examining responses on specific items from the formative measure (28) to understand aspects of feasibility, both teachers and CHVs expressed high agreement with "I believe I am sufficiently skilled at providing *Pamoja Tunaweza/TF-CBT*" at post-implementation (*M* = 4.60, *SD* = 0.72; *M* = 4.80, *SD* = 0.41, respectively), with all but two responses in the 4 ("agree") to 5 ("strongly agree") range.

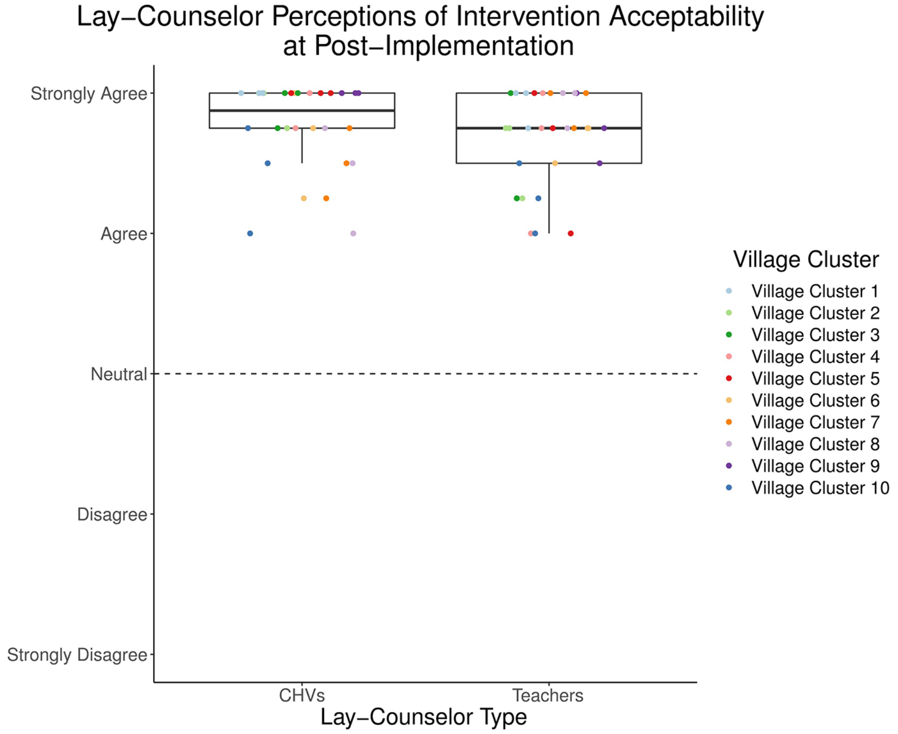

FIGURE 2 | Lay counselor perceptions of intervention acceptability at post-implementation.

TABLE 2 | Reflective and Formative Measures of Acceptability among Teachers and CHVs at Post-Implementation.

	Teachers (*N* = 30)			CHVs (*N* = 30)		
Reflective Measure¹	**Mean**	**SD**	**Range**	**Mean**	**SD**	**Range**
Acceptability of Intervention²	4.67	0.34	(4,5)	4.77	0.31	(4,5)
Items from Formative Measures¹						
I liked providing PT/TF-CBT	4.63	0.49	(4,5)	4.87	0.35	(4,5)
I felt good about providing PT/TF-CBT	4.73	0.45	(4,5)	4.83	0.38	(4,5)
I continue to enjoy learning PT/TF-CBT	4.69	0.47	(4,5)	4.90	0.31	(4,5)
I felt that the components of PT/TF-CBT made sense to me	4.73	0.52	(3,5)	4.77	0.43	(4,5)
I was satisfied with the supervision I received when I provided PT/TF-CBT	4.50	0.82	(1,5)	4.70	0.47	(4,5)

CHV, Community Health Volunteer; SD, Standard Deviation; PT/TF-CBT, Pamoja Tunaweza/Trauma-focused Cognitive Behavioral Therapy.
¹Items measured on a five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree).
²Mean of four items; range reflects minimum and maximum across all four items.

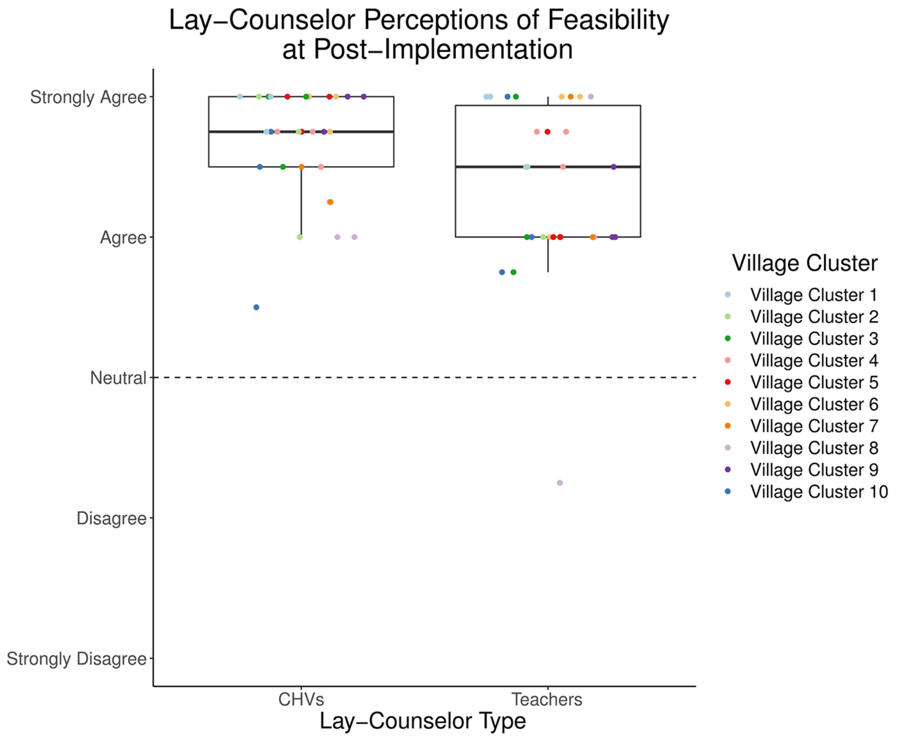

FIGURE 3 | Lay counselor perceptions of intervention feasibility at post-implementation.

Although both teachers and CHVs also expressed high agreement with "I have enough time for all activities that go into providing *Pamoja Tunaweza*/TF-CBT" (*M* = 4.07, *SD* = 0.58; *M* = 4.57, *SD* = 0.50, respectively), responses from teachers were more varied (2–5 range; 2 corresponding to "disagree") than those for CHVs (4–5 range). Among the most highly endorsed statements for both teachers and CHVs was "I am able to reach my *Pamoja Tunaweza*/TF-CBT supervisor when needed" (*M* = 4.67, *SD* = 0.55; *M* = 4.57, *SD* = 0.68, respectively). Looking across all items on the formative measure, all but two items at post-implementation had average responses in the 4 ("agree") to 5 ("strongly agree") range. Two items within the resources domain were rated the lowest and had the greatest variability across respondents. Both teachers and CHVs rated this item the lowest at post-implementation: "I have the right equipment (e.g., pens/pencils/chalk, paper, exercise books, slip [flip] charts, mark pens) to regularly provide *Pamoja Tunaweza/TF-CBT*" (*M* = 3.70, *SD* = 1.15; *M* = 3.43, *SD* = 1.19, respectively). Another relatively lower-rated resource item, by

TABLE 3 | Reflective and Formative Measures of Feasibility among Teachers and CHVs at Post-Implementation.

	Teachers (*N* = 30)			**CHVs (*N* = 30)**		
Reflective Measure[1]	**Mean**	**SD**	**Range**	**Mean**	**SD**	**Range**
Feasibility of Intervention[2]	4.35	0.60	(2,5)	4.67	0.40	(2,5)
Items from Formative Measures[1]						
I believe I am sufficiently skilled at providing PT/TF-CBT to orphans	4.60	0.72	(2,5)	4.80	0.41	(4,5)
I have enough time for all the activities that go into providing PT/TF-CBT	4.07	0.58	(2,5)	4.57	0.50	(4,5)
I have enough time to spend in supervision activities (e.g., attending supervision, practicing) related to PT/TF-CBT	4.00	0.74	(2,5)	4.60	0.50	(4,5)
I have enough time to travel to and from PT/TF-CBT groups	NA	NA	NA	4.57	0.50	(4,5)
I am provided with necessary transportation to regularly provide PT/TF-CBT	NA	NA	NA	4.17	0.91	(2,5)
I have the right equipment (e.g., pens/pencils/chalk, paper, exercise books, flip charts, etc.)	3.70[3]	1.15	(1,5)	3.43	1.19	(1,5)
I have the resources (e.g., phone, talk time) to reach my clients and/or PT/TF-CBT supervisor in between sessions when needed	4.03[3]	0.89	(2,5)	3.83	0.91	(2,5)
I have sufficient access to a private space to meet with orphans and guardians receiving PT/TF-CBT	4.43	0.68	(2,5)	4.63	0.49	(4,5)
I have access to a space for individual visits with orphans and guardians	4.23	0.63	(2,5)	4.60	0.50	(4,5)
I am able to reach my PT/TF-CBT supervisor when needed	4.67	0.55	(3,5)	4.57	0.68	(2,5)
I have sufficient access to continued PT/TF-CBT intervention support and training	4.33[3]	0.84	(1,5)	4.60	0.50	(4,5)
I have access to the emotional support I may need to handle any stress related to delivering PT/TF-CBT (e.g., hearing stories about their parent death)	4.37	0.56	(3,5)	4.50	0.57	(3,5)
PT/TF-CBT is too complex to do in this school/community	1.90	0.71	(1,4)	1.50	0.73	(1,4)
Average hours per week on PT/TF-CBT (e.g., preparing, delivering, reports, visits)	3.42	1.35	(1,6)	5.13	3.03	(1,12)

CHV, Community Health Volunteer; SD, Standard Deviation; PT/TF-CBT, Pamoja Tunaweza/Trauma-focused Cognitive Behavioral Therapy; NA, Not Applicable.

[1] Items measured on a five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree).

[2] Mean of four items; range reflects minimum and maximum across all four items.

[3] These items did not correlate highly with the reflective, Feasibility of Intervention Measure.

both counselor types, was: "I have the resources (e.g., phone, talk time) to reach my clients and/or *Pamoja Tunaweza*/TF-CBT supervisor in between sessions when needed*"* (M = 4.03, SD = 0.89; M = 3.83, SD = 0.91 respectively).

One item assessed intervention complexity, "*Pamoja Tunaweza*/TF-CBT is too complex to use in this school/community," with both teachers and CHVs endorsing disagreement (M = 1.90, SD = 0.71; M = 1.50, SD = 0.73, respectively) (**Table 3**). All but six counselors endorsed 1 ("strongly disagree") or 2 ("disagree"). Another question assessed "On average, how many hours per week do you spend on *Pamoja Tunaweza*/TF-CBT (e.g., preparing for sessions, delivering sessions, and supervision)" (**Table 3**). CHVs reported more weekly hours spent on *Pamoja Tunaweza*/TF-CBT (M = 5.13, SD = 3.03, Range = 1–12) than teachers (M = 3.42, SD = 1.35, Range = 1–6) at post-implementation.

Appropriateness

Descriptive statistics for all items from the formative measure are included in **Table 4**. Examining provider-referenced items at post-implementation, teachers and CHVs endorsed high agreement with "I believe that teachers/CHVs should be providing *Pamoja Tunaweza/TF-CBT*" (M = 4.43, SD = 0.68; M = 4.90, SD = 0.40, respectively), with responses in the 3–5 range for both groups. At the mean level, most teachers and CHVs also endorsed high agreement with "From my perspective, providing Pamoja Tunaweza/TF-CBT is something I feel I should be doing as part of my [job duties]" (M = 4.47, SD = 0.73; M = 4.83, SD = 0.46, respectively). Nearly all CHVs "strongly agreed" whereas 60% of teachers "strongly agreed" and more teachers endorsed a lower rating of "moderately." Examining organization-referenced items at post-implementation, teachers and CHVs endorsed high agreement with "Providing *Pamoja Tunaweza*/TF-CBT will be useful for my school/community." All teacher responses were in the 3 ("moderately") to 5 ("extremely") range (M = 4.57, SD = 0.63); all CHVs responded to this item with a 5 ("extremely"). Teachers and CHVs also endorsed high agreement with "Providing *Pamoja Tunaweza*/TF-CBT fits with the goals of my school/community," although there was more variability in teachers' responses (M = 4.13, SD = 0.78; M = 4.93, SD = 0.25, respectively).

TABLE 4 | Formative Measure of Provider and Organizational Appropriateness reported by Teachers and CHVs at Post-Implementation.

	Teachers (N = 30)			CHVs (N = 30)		
Provider Level Appropriateness[1]	**Mean**	**SD**	**Range**	**Mean**	**SD**	**Range**
I believe that I should be providing PT/TF-CBT	4.23	0.68	(3,5)	4.83	0.38	(4,5)
I believe that teachers/CHVs should be providing PT/TF-CBT	4.43	0.68	(3,5)	4.90	0.40	(3,5)
From my perspective, providing PT/TF-CBT is something I feel I should be doing as part of my job	4.47	0.73	(3,5)	4.83	0.46	(3,5)
From my perspective, attending supervision for PT/TF-CBT is something I feel I should be doing as part of my role as a teacher/volunteer activities as a CHV	4.43	0.68	(3,5)	4.67	0.71	(3,5)
Organizational Level Appropriateness[1]						
I believe that the school/community should be responsible for providing psycho-social education (including psycho-social counseling, psycho-social support or mental health treatment) for orphaned children	4.33	0.80	(3,5)	4.73	0.64	(3,5)
PT/TF-CBT fits with our school/community's approach to helping orphaned children	4.13	0.78	(3,5)	4.93	0.25	(4,5)
Providing PT/TF-CBT fits with the goals of my school/community	4.13	0.78	(3,5)	4.93	0.25	(4,5)
Providing PT/TF-CBT will be useful for my school/community	4.57	0.63	(3,5)	5.00	0.00	(5,5)

CHV, Community Health Volunteer; SD, Standard Deviation; PT/TF-CBT, Pamoja Tunaweza/Trauma-focused Cognitive Behavioral Therapy.

[1]Items measured on a five-point scale ranging from 1(not at all) to 5(extremely).

DISCUSSION

Overall

Lay counselors in both Education and Health endorsed high acceptability, feasibility, and appropriateness of TF-CBT after implementing *Pamoja Tunaweza*/TF-CBT. Our results provide preliminary evidence that lay counselors in both sectors perceived TF-CBT to be a satisfactory intervention (acceptability), doable in their respective settings (feasibility), and that delivering TF-CBT is compatible with their role and sector's approach to helping children (appropriateness). Our findings suggest that using task-shifting to deliver mental health services through Education and community health extension in western Kenya is a promising approach for potential scale up and sustainment.

The formative measures provide some context as to why lay counselors in both sectors rated TF-CBT favorably and also may suggest some differences across lay counselors from the two sectors. The high ratings for acceptability among lay counselors in both sectors are notable given demographic differences in these groups and differences in their primary roles. For instance, teachers generally reported more advanced education levels than CHVs, yet both endorsed favorable ratings with regard to TF-CBT making sense to them and feeling sufficiently skilled in TF-CBT delivery. Our findings mirror those from other studies, in which lay counselors with varied educational backgrounds have competently delivered multi-component mental health interventions that include some complex elements (e.g., cognitive processing; 46). At least among this sample of the first implementing schools and communities in BASIC, our findings are aligned with Murray and colleagues (24) who found high TF-CBT acceptability among Zambian lay counselors. In our study, there appears to be greater variability in satisfaction with the supervision received among teachers compared to CHVs. Other research notes the importance of supervision, particularly for task-shifting (22). It will be important for our research team, and other groups undertaking implementation efforts involving task-shifting, to quickly identify any challenges with supervision as well as identify any factors that may be associated with lower satisfaction with supervision. Teachers' responses on other formative items from the feasibility scale may provide some insight into factors that can be investigated with the larger sample (e.g., high endorsement for ability to reach the supervisor when needed, lower endorsement for having the time to engage in supervision).

Overall, counselors seem to perceive TF-CBT to be highly feasible, but there was more variation in feasibility, compared to acceptability and appropriateness, and there appears to be some variability across the two counselor types. Not surprisingly given the resource-constrained context, both teachers and CHVs seem to rate the availability of resources needed both to deliver the intervention (e.g., paper, chalk) and communicate with clients and supervisors (e.g., phone credit) lower than other aspects of feasibility. These findings reflect Padmanathan and De Silva's (2013) identification of resources as a primary barrier to task-shifting mental health care, and underline the importance of planned implementation coaching for subsequent schools and communities in BASIC (33). While we did not engage in formal statistical testing of differences, there appear to be some differences in how feasibility was perceived across the two sectors. Teachers' perceptions of feasibility, although still high, had greater variability than did CHV perceptions (**Figure 3**). Teachers were delivering TF-CBT and finding time to participate in supervision on top of their full-time positions as teachers and were often constrained by schools' schedules. In comparison, CHVs were engaged in part-time voluntary work, with greater schedule flexibility. Given their part-time work, they may have found it easier to incorporate TF-CBT delivery and supervision participation into their week. In another interesting comparison, CHVs' estimates of how many hours TF-CBT required per week were nearly double those of teachers. Potentially, due to greater flexibility in CHVs tasks and voluntary work, it is possible for them to dedicate more time to preparation and delivery of the intervention. Alternately, given that most of the teachers had many years of teaching experience, their experience developing and delivering lesson plans may have allowed them to be efficient with their preparation time. It is notable that feasibility ratings were generally positive for lay counselors in both sectors. Findings from counselors in these first 10 schools and communities suggest that a multicomponent, multisession mental health intervention may be feasibly delivered by lay counselors in different sectors with varying levels of workload and competing demands.

Lay counselors in both settings generally reported that TF-CBT fit with them individually and their respective roles, as teachers or as CHVs. This high role appropriateness for two very distinct roles and sectors suggests that interventions such as TF-CBT may fit for lay counselors with varied task demands, primary roles, and time availability. Interestingly, there appears to have been more variability in lay counselors' ratings of setting or context appropriateness of TF-CBT (compared to appropriateness for their own roles). All CHVs felt that TF-CBT would be useful for their community whereas teachers had positive, but more varied responses. Similarly, ratings of the fit of TF-CBT with one's setting appear higher for CHVs, who are situated within the community health extension context, than for teachers, who are situated within the school context. This may reflect differences in feasibility (noted above) or may highlight the importance of considering the primary goals of a particular setting when moving mental health treatments into non-traditional settings. For instance, schools' primary goals are academic, which may affect the implementation of interventions for which academics may not be the primary goal (47). Research increasingly supports the positive impact of mental health interventions on child academic outcomes (48, 49). Anecdotally, teachers who provided TF-CBT as part of BASIC shared stories of improved academic performance among children who received TF-CBT, and our team is seeking further funding to empirically examine academic outcomes for children who receive TF-CBT. With a new academic policy in Kenya encouraging a holistic education for children (50), mental health interventions may increasingly be perceived as a better fit for the Educational context.

Accurate and valid measurement is crucial to advance the fields of implementation science and global mental health, yet there are limited measures of implementation constructs and little research exists on their reliability or validity (28, 51–53). Valid and pragmatic measurement is essential to facilitating implementation and addressing stakeholder issues (54). We were able to use recently developed measures validated in the United States (29), measures specifically developed for task-shifted mental health interventions in LMICs (28), and the relatively recent Theoretical Domains Framework (42). While the Weiner measures were useful in assessing lay counselors' perceptions of intervention acceptability and feasibility, they were not designed to provide insight on *why* lay counselors held these perceptions. The combined reflective and formative approach provided a way to both assess an underlying construct (e.g., 29) and obtain an understanding of what specific aspects led to it being perceived as acceptable, feasible, and appropriate. Use of similar approaches in other global mental health implementation studies may allow for some common measurement using reflective measures, but specificity from formative measurement. We felt the approach allowed for a deeper understanding of acceptability, feasibility and appropriateness in these two sectors, with some indication of implementation supports needed and how we might tailor support by setting. Findings from measures used in our approach mirror anecdotal evidence from counselors and coded qualitative interviews at post-implementation with a subset of these 60 counselors (55). Both teachers and CHVs have continued to deliver *Pamoja Tunaweza*/TF-CBT for a year following the post-implementation data collection point. As they have continued to deliver the intervention, they have made some adaptations to delivery to fit their context. In academic terms of shorter duration (term 3) counselors have delivered 2 groups in one week. Teachers and CHV counselors have developed strategies to support one another, based on their role and location, with teachers using their daily access to children (in the school/classroom) to remind guardians to attend groups by sending children home with reminder notes for their guardians. CHVs, who are embedded in the community, have been able to do more outreach with guardians who experience attendance problems (due to time constraints because of work or lower interest in group participation).

Limitations

These findings should be considered within a number of study limitations. First, the findings are from only the first sequence in a larger SW-CRT. Our sample size in each sector is small. Results may be different after all 240 lay counselor participants are enrolled. However, the random selection and ordering process optimizes the validity of the selection of village clusters and the relatively consistent favorable scores across multiple measures of acceptability, feasibility, and appropriateness is encouraging. Second, due to the small sample, we did not consider it appropriate to conduct formal statistical tests of differences across lay counselors from the two sectors or to examine constructs that might predict low or high ratings of our constructs of interest. Third, internal consistency for the reflective measure of acceptability was just below the commonly held 0.70 thresholds and two IICs from the CHV surveys of feasibility were below the 0.20 threshold. These reflective measures hold promise given their brevity and seeming applicability, but more measurement work will be needed, with a larger sample, to determine if they are performing as expected with more diverse provider types and contexts. Fourth, while the JHU Implementation measures were designed for lay counselor delivery and use in low-resource contexts, some items required adaptation to fit our intervention and contexts and additional items were needed to capture aspects of feasibility and appropriateness considered important by the study team. The tension between using standardized measures when possible, and adapting and tailoring measures to fit the context is a difficult one to balance. Following recommendations of Martinez et al. (52), we have attempted to be clear about any measure adaptations in our measures section and included all items in our tables. We also plan to do more psychometric work on our measures with the full sample of lay counselors. Finally, findings from this study may not generalize to different regions or schools (e.g., secondary schools), given our desire to situate the study within the Kenyan context, and specifically, their community health extension program. Our lay counselor sample may also limit generalizability, as many of them indicated receiving some prior psychosocial training. Prior experience may have influenced lay counselors' perspectives on the intervention's acceptability, feasibility, and appropriateness.

CONCLUSIONS

Task-shifting mental health care provides an approach for addressing the shortage of mental health professionals globally. In this study in western Kenya, lay counselors in both the Education and Health sectors found an evidence-based treatment for children and adolescents who had experienced parental death, TF-CBT, to be highly acceptable, feasible, and appropriate. Our findings suggest that, at least in terms of perceptions of the lay counselors delivering the intervention, despite differences in the lay counselors' roles and context, both sectors hold promise as potential options for scaling up mental health treatment delivery.

DATA AVAILABILITY STATEMENT

The datasets for this manuscript are not publicly available because we cannot guarantee protection of study subjects' confidentiality if we make the raw data publicly available. We are investigating ways to create limited de-identified datasets that maintain participant confidentiality for broader use upon completion of the study. Datasets are available upon request to the MPIs.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Duke University Institutional Review Board and the Kenya Medical Research Institute Institutional Review Board. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

SD, RM, PM, NT, GW, CS, CA and CG wrote the paper. SD, KW, CS, and AW conceptualized the overall study. CG analyzed the data. SD, RM, PM, LL, NT, CG, CS, CA, AW, and KW interpreted the results and contributed to the construction of the *Discussion* section.

FUNDING

Funding for this research project was supported by a grant to the first and last authors by the National Institute of Mental Health (R01 MH112633; Dorsey and Whetten, MPIs).

ACKNOWLEDGMENTS

We wish to thank project staff from the University of Washington, Duke University, and Ace Africa, specifically Andrew Weinhold, Kelly Thompson, Lillian Aluka, Bernard Nambafu, Sheila Nderitu, Daisy Okoth, Anne Omariba, Elijah Agala, Oliver Hillary, Emmanuel Muli, Micah Nalianya, Michael Nangila, Victor Shalakha, Annette Sulungai, Sylvia Wafula, and Nelly Wandera. We are indebted to all the community partners and lay counselors in Education and the Health sectors. Their hard work, dedication, and high integrity made this research possible. We gratefully acknowledge the ongoing support of the Ministries of Health and of Education. We also thank Bryan Weiner, Laura Murray, and Emily Haroz for their support.

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Conflict of Interest: The first author, SD, and last author, KW, have received grant funding to test TF-CBT.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 14 February 2020
doi: 10.3389/fpsyt.2020.00043

Influence of Socio-Economic Status on Psychopathology in Ecuadorian Children

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Specialty section:
This article was submitted to
Child and Adolescent Psychiatry,
a section of the journal
Frontiers in Psychiatry

Received: 11 April 2019
Accepted: 16 January 2020
Published: 14 February 2020

Citation:
Pérez-Marfil MN,
Fernández-Alcántara M, Fasfous AF,
Burneo-Garcés C, Pérez-García M
and Cruz-Quintana F (2020) Influence
of Socio-Economic Status on
Psychopathology
in Ecuadorian Children.
Front. Psychiatry 11:43.
doi: 10.3389/fpsyt.2020.00043

The socioeconomic status (SES) of parents has been reported to have a crucial impact on emotional competence in childhood. However, studies have largely been carried out in developed countries and in children in a specific age range, and it is not clear whether the effect of the SES of parents varies by age. The objective of this study was to investigate the psychopathological profile (including externalizing and internalizing problems) of children aged 7, 9, and 11 years old with low SES in a developing country (Ecuador). The study included 274 children (139 boys and 135 girls), who were divided between medium-SES (n = 133) and low-SES (n = 141) groups. Data were gathered on socioeconomic and anthropometric variables of the children, and the parents completed the Child Behavior Check-List (CBCL). In comparison to the medium-SES group, children in the low-SES group obtained higher scores for internalizing and externalizing symptoms and for total problems, and they obtained lower scores for social competence skills. The housing risk index and school competence were the two main predictors of internalizing and externalizing problems in this population.

Keywords: socioeconomic status, psychopathology, internalizing, externalizing, anthropometric measures, child behavior

INTRODUCTION

Neurodevelopment is a dynamic inter-relationship among genetic, cerebral, cognitive, emotional, and behavioral processes over life (1). Emotional competence and skills can be influenced by nutritional, infectious, and toxic factors and by upbringing practices and patterns (2), as well as by the socio-economic status (SES) of parents (3–6).

SES consists of numerous factors, including family income, parental education and occupation, psychological and physical health status, physical conditions at home, upbringing practices, stressful situations suffered by child and/or parents, physical or psychological abuse, and nutritional status (7–11). It has been reported that low SES can be a risk factor for inadequate socio-emotional development and can increase vulnerability to development problems (12–14). Various theoretic models have been proposed for the impact of SES on neurodevelopment, considering different explanatory variables. Thus, a low SES has been associated with: external factors, related to the environment with which the child interacts; and internal factors, more related to interactions with parental figures.

External factors are considered in the model by Evans, among others, in which a low SES is associated with greater exposure to environmental risk, which in turn increases the risk of physical and psychological disorders. The review by Evans and Kantrowitz (15) identified a large number of environmental stressors that can indirectly influence the physical and emotional health of children living in poverty, including: lower air quality, larger presence of environmental toxins, higher ambient noise, greater residential crowding, lower housing quality, and worse educational facilities.

Numerous theoretic models have focused on the influence of low SES and poverty on the interaction between parents and children, acknowledged to be a crucial factor (16, 17). Although no unified model has been published that considers all stressors associated with a low SES, certain key factors have been identified (18), including parental investment, parental practices, levels of chronic stress, and coping (8, 19, 20). Parental investment refers to the quality of cognitive stimulation at home, including the availability of books, electronic devices, and toys and the amount of time spent watching television. Parental practices refer to the interaction or involvement of parents in their children's care. It has been suggested that these practices are characterized by greater hostility and conflict in a low SES environment, with less care and support of the children and inconsistent punishment and reward patterns, favoring the development of internalizing and externalizing problems in the children (21). Finally, children with low SES have been found to have lower skills to deal with these stressors, which can accumulate over time and interact with each other, as well greater difficulty in controlling their emptions (19).

Middle childhood (7–11 years) appears to be a crucial stage for the regulation of emotions and for the onset of psychopathologic disorders It is a time when social skills develop, sexual differences are maximized, and important interactions between environmental and genetic factors can be observed (22). In this pre-adolescent stage, there is a marked development of executive function and self-regulatory capacities (23) but also a greater risk of psychopathologic problems. It has been reported that psychopathologies appearing during infancy start to increase at the age of 5–6 years and reach their main peak in middle childhood (24) and that the likelihood of such problems at this stage is increased in a low SES environment (25).

Recent studies on the association between a low SES and psychopathologic aspects showed that children from poorer backgrounds experience greater difficulties in controlling impulses and delaying gratification (26). It has also been observed that the accumulation of multiple risks (e.g., deficits in education, mistreatment, or lack of parental attention) during early infancy can predict a lower capacity for emotional self-regulation, with difficulties in controlling emotions and in co-operating with peers and independent play (10, 27–29).

Special interest has been shown in the relationship between SES and the development of mental health problems in children and adolescents, specifically internalizing and externalizing problems, (4, 25). It is estimated that around 20% of children and adolescents worldwide have mental health problems (30), which are considered to be two- to three-fold more prevalent in children of families with low SES (31). The influence of this condition on the short- and long-term development of mental health problems is considered to be more marked during the first months of life (31). However, it has also been found that children and adolescents growing up in a low SES environment have more internalizing (e.g., anxiety and depression) and externalizing (e.g., aggressiveness, opposition, and hyperactivity) symptoms, although findings have not been consistent (4).

There have been attempts to identify the mechanisms underlying the effect of SES on the mental health of children. Bøe and colleagues (4) reported that the emotional wellbeing of parents and their upbringing practices may act as mediator of the interaction between SES and mental health problems in children. They observed that the family economy and the educational level of parents affected the mental health of children in different ways. Thus, the family economy was related to the presence of externalizing problems through the emotional wellbeing of parents and upbringing practices, while the educational level of the mother was related to externalizing problems through negative disciplinary methods. In the case of internalizing problems, direct and indirect associations were found with the family economy, mediated by maternal emotional wellbeing and upbringing practices (4).

However, research to date has been limited. Despite the clear relationship between SES and mental health problems in children, few data are available on the prevalence of these problems, on the most frequent types of disorder, or on possible comorbidities (4, 31). One objective of developmental psychopathology has been to analyze the heterogeneity of symptoms presented by children with behavior problems, with the aim of identifying subgroups with similar difficulties for specific treatment approaches (14). However, there has been inadequate consideration of the cultural setting or the country's level of development, with most research being conducted in developed nations (11, 32). In addition, most studies have focused more on the economic aspects of SES and less on the possible influence of other important factors, such as the educational level of parents (14). The family economy and educational level of parents may have differential influences on family processes and children's socio-emotional adjustment. The upbringing of children may be directly affected by the educational level of parents and indirectly affected by the family economy *via* effects on parental emotional wellbeing and mental health. Analysis of individual SES components is needed to determine their specific contribution to the socio-emotional adjustment of children. Thus, Merz et al. (25) reported that anxiety and depression levels of children were negatively related to the educational level of parents but were not associated with family income. Finally, the duration of exposure to a low SES environment can determine the likelihood of psychopathologic problems, so that it is important to take the age of children into account. Various reviews have concluded that experiences of poverty during early childhood can have a damaging effect on both cognitive and emotional development (21). In this line, recent studies have described significant interactions between the age of children and SES levels in verbal memory, phonetic fluency, abstract reasoning, and inhibitory control (13).

Limited data are available on the relationship of SES with the development of psychopathologies during middle childhood. Therefore, the aim of this study was to investigate socio-emotional development in children of 7, 9, and 11 years of age exposed to low or medium SES in a city in a developing country (Guayaquil, Ecuador). The study hypothesis was that the children with low SES would have more emotional (externalizing and internalizing) problems in comparison to the children with medium SES.

METHOD

Participants

The study included 274 Spanish-speaking schoolchildren from Guayaquil, the most populous city of Ecuador, divided among 7-year-olds (45 boys, 44 girls), 9-year-olds (45 boys, 46 girls), and 11-year-olds (47 boys, 45 girls). These ages were selected to allow investigation of the relationship between SES and psychopathologic changes throughout middle childhood.

The study population was divided by SES between: a medium-SES group (n = 133) containing 45 7-year-olds (23 boys, 22 girls), 44 9-year-olds (22 boys, 22 girls), and 44 11-year-olds (22 boys, 22 girls); and a low-SES group (n = 141) containing 46 7-year-olds (24 boys, 22 girls), 47 9-year-olds (23 boys, 24 girls), and 48 11-year-olds (25 boys, 23 girls).

Sampling Procedure

The study was conducted in primary schools in the city, selected to provide a balanced representation of areas with predominantly low-SES or medium-SES populations. Random sampling was conducted among the 7-, 9-, and 11-year-old children registered at each participating school.

The characterization of school catchment areas as low or medium SES and their inclusion in the study was based on multiple factors, including: the private, subsidized, or public funding of the school; basic services in the area; and income and employment levels, among others. Following these criteria, a selection was made of three medium-SES schools (one public, one subsidized, and one private) in the north/center of the city and two low-SES schools (two public schools) in an area at the southern edge of the city "Isla Trinitaria," surrounded by an inlet of the sea. The population of Isla Trinitaria has considerably increased over the past 20 years, with a major influx of people from other parts of the country, and it currently has around 350,000 inhabitants. It is considered to be one of the poorest zones in the metropolitan area of Guayaquil and did not have access to basic services until 2011, when power lines and a fresh drinking water system were installed, followed by an expansion of the sewage network in 2013. However, major public investment is required in health, education, security, roads, and public transport, among others, before the population of this area can enjoy the same quality of life and opportunities as the majority of the city dwellers (medium-SES).

Inclusion Criteria

Study inclusion criteria were: a) age of 7, 9, or 11-years at the time of assessment; b) regular attendance at one of the participating schools; c) absence of physical, psychological, or cognitive impairment diagnosed by a specialist or reported by teachers or parents; and d) informed consent signed by parent/guardian. Before evaluation of the selected children, interviews were conducted with their teachers and with their parents/guardians to verify that the above inclusion criteria were met, confirming that none had diagnosed or apparent physical or psychological disorders or evidenced major behavioral problems. The availability of an appropriate room for interviews with the children was also established. Out of the eligible children enrolled in the study, 24 were subsequently excluded due to the withdrawal of consent (n = 4) or because conditions for the assessment were not adequate due to interruptions for school activities (n = 20).

Instruments

Socioeconomic Status

Socioeconomic Survey

The questionnaire was developed by the School of Nursing of the University of Guayaquil (33) as part of its Child and Adolescent Care Program and was designed to gather data on the socioeconomic level of the families of children. This questionnaire was administered to the parents/guardians in interviews held at the school of their children (afternoon sessions).This instrument classifies families according to raw scores for maternal level of education level (score range of 1–4) and social class of the head of household (score range of 1–4), and a transformed housing risk index, including house structure, overcrowding, water supply, garbage disposal, toilet availability, and sewage disposal (score range of 1–3). A higher questionnaire score indicates lower socioeconomic level.

Anthropometric Measurements

Measurements were taken of the height, weight, and cranial and abdominal circumferences of the children, using: a SECA wall plastic height scale, model 206 (Hamburg, Germany) with measurement range of 0–220 cm; a SECA digital floor scale, model 803 (Hamburg, Germany) with a limit of 150 kg in 100 g increments; and a SECA measuring tape, model 201 (Hamburg, Germany), an ergonomic and flexible band to measure circumferences, with a range of 0–250 cm in 1 mm increments.

Psychopathology

Child Behavior Checklist in 6- to 18-Year-Olds

The Child Behavior Checklist (CBCL) (34) was used to obtain information from the usual guardians of the children on the children's skills or competences (Social Competence Scale), problematic behaviors (Problems Scale), and Diagnostic and Statistical Manual (DSM)-oriented problems. The social competence items yield scores for three narrow-band scales (activities, social, and school) and one broad-band scale (total social competence). The Problems Scale evaluates eight syndromes: somatic complaints, anxiety, depression, social problems, thought problems, attention problems, rule-breaking behavior, and aggressive behavior. It also allows assessment of two large groups of syndromes: internalizing problems (combining withdrawal, somatic complaints, and anxiety/depression) and externalizing problems (combining rule-breaking behavior and aggressive behavior). The DSM-oriented problems include affective problems, anxiety problems, somatic problems, attention deficit/hyperactivity problems, oppositional defiant problems, conduct problems, sluggish cognitive tempo, obsessive-compulsive problems, and post-traumatic problems. Administration of the CBCL takes 25–30 minutes. Correlation coefficients of .90 were obtained for mean scores between different examiners and between two parental reports separated by 7 days (test-retest reliability). Correlation coefficients for the repeated parental reports were .87 for the Social Competence Scale and.89 for the Problems Scale. The CBCL has been adapted to a wide number of Spanish-speaking countries including Spain, Chile, Mexico, and Puerto Rico (35). In the present study the Spanish version of the CBCL was used (35, 36). To stablish the cut-off scores in the present population, the recommendations of Achenbach and Rescorla (37) were considered.

Procedure

A team of six trained evaluators carried out the fieldwork during a 4-month period. Interviews and anthropometric measurements of the children were conducted at school during the morning in a room with adequate physical conditions for this purpose. Parents attended a 30-min interview in the afternoon at their children's school to record their socioeconomic data and complete the CBCL. Written consent was obtained from the parents/guardians of the children for their participation in the study, which was approved by the ethical committee of the local University (Ref: A3/042954/11).

Data Analysis

After descriptive analysis of the data, ANOVAs were conducted with 2x2x3 factorial design considering two SES groups (medium and low), two sex groups (boy and girl), and three age groups (7, 9, and 11 years) as independent variables and CBCL subscales, parental socioeconomic survey subscales, and anthropometric variables as dependent variables, followed by application of the *post-hoc* Bonferroni test. The chi-square test was also applied to evaluate differences among groups in the percentage of clinical problems in each CBCL scale. Finally, linear regression analyses were performed to identify the SES components and social competences with greatest influence on internalizing, externalizing, and total problems of the CBCL. Given the need for multiple comparisons, the Bonferroni correction was applied to reduce the probability of a type I error, establishing the significance threshold at ≤ 0.002 for ANOVAs and ≤ 0.006 for linear regressions. Partial eta-squared was used as effect size measure.

RESULTS

Before the statistical analyses were performed, the SES classification of participants was tested by considering their maternal education, home risk index, and the social class of head of household. Results confirmed that the classification of the children was appropriate, with the low-SES group scoring significantly higher (i.e., lower SES) for maternal education level [$F(1,260) = 249.04$, $p < .001$; partial $\eta^2 = .522$], home risk index [$F(1,260) = 104.91$, $p < .001$; partial $\eta^2 = .290$], and social class of head of household [$F(1,260) = 256.19$, $p < .001$; partial $\eta^2 = .502$]. No significant differences were observed in these scores as a function of the child's age (see **Table 1**).

Differences in Anthropometric Variables Between Groups

Results for anthropometric characteristics were as follows: a) weight varied according to the SES, $F(1,258) = 38.54$, $p < .001$ (partial $\eta^2 = .130$), and age, $F(2,258) = 83.12$, $p < .001$ (partial $\eta^2 = .392$); b) height varied according to the SES, $F(1,258) = 14.29$, $p < .001$ (partial $\eta^2 = .052$), and age, $F(2,258) = 207.64$, $p < .001$ (partial $\eta^2 = .617$); c) the abdominal circumference varied according to the SES, $F(1,258) = 62.46$, $p < .001$ (partial $\eta^2 = .195$), and age, $F(2,258) = 34.19$, $p < .001$ (partial $\eta^2 = .210$); and d) the cranial circumference varied according to the SES, $F(1,258) = 45.38$, $p < .001$ (partial $\eta^2 = .150$), and age, $F(2,258) = 13.55$, $p < .001$ (partial $\eta^2 = .095$) (see **Table 1**). In all cases, values were lower for the children in the low-SES group than for the children in the medium-SES group. In regard to age, *post-hoc* analyses showed differences among the three age groups, with lower scores for the younger than older children. There were also differences for the main effect of the sex variable on head circumference, whose values were higher in boys than in the girls. Finally, the age x sex interaction was significant for height, with differences between boys and girls in the 9- and 11-year-old age groups.

Differences Between Socioeconomic Status Groups in Psychopathology and Social Competence

A significant difference between SES groups were found for all syndromes gathered in the CBCL except for thought problems (**Table 2**). In comparison to the medium-SES group, the low-SES group obtained higher scores for depression, $F(1,258) = 39.234$, $p < .001$ (partial $\eta^2 = .132$); somatic complaints, $F(1,258) = 21.021$, $p < .001$ (partial $\eta^2 = .075$); social, $F(1,258) = 35.566$, $p < .001$ (partial $\eta^2 = .121$); attention problems, $F(1,258) = 49.792$, $p < .001$ (partial $\eta^2 = .162$); rule-breaking behavior, $F(1,258) = 38.436$, $p < .001$ (partial $\eta^2 = .130$); and aggressive behavior, $F(1,258) = 47.404$, $p < .001$ (partial $\eta^2 = .155$).

As shown in **Table 3** (CBCL psychopathologic scales), the low-SES group obtained higher scores than the medium-SES group in internalizing problems $F(1,258) = 30.757$, $p < .001$ (partial $\eta^2 = .107$); externalizing problems, $F(1,258) = 52.174$, $p < .001$ (partial $\eta^2 = .168$); and total problems, $F(1,258) = 61.362$, $p < .001$ (partial $\eta^2 = .192$).

TABLE 1 | Group, age, and sex differences and interaction on socioeconomic, anthropometric, and nutritional measures.

Measures	Group	7 years		9 years		11 years		*p*	*Post hoc*
	Medium-SES (n = 133) Low-SES (n = 141)	**Boy (n = 45) ME (SD)**	**Girl (n = 44) ME (SD)**	**Boy (n = 45) ME (SD)**	**Girl (n = 46) ME (SD)**	**Boy (n = 47) ME (SD)**	**Girl (n = 45) ME (SD)**		
Socioeconomic characteristics									
Maternal education level	Medium	1.38 (0.50)	1.76 (0.70)	1.55 (0.75)	1.57 (0.75)	1.68 (0.78)	1.62 (0.59)	Group**	ME < L
	Low	3.43 (1.08)	3.30 (1.08)	3.61 (1.37)	3.67 (1.17)	3.80 (1.23)	3.35 (0.78)		
Housing risk index	Medium	1.10 (0.30)	1.24 (0.44)	1.27 (0.46)	1.38 (0.50)	1.23 (0.43)	1.10 (0.30)	Group**	ME < L
	Low	1.87 (0.46)	1.85 (0.37)	1.74 (0.45)	1.83 (0.48)	1.68 (0.48)	1.65 (0.49)		
Social class of head of household	Medium	1.76 (0.70)	2.05 (0.74)	1.68 (0.65)	1.95 (0.67)	2.18 (0.96)	2.05 (0.81)	Group**	ME < L
	Low	3.48 (0.67)	3.15 (0.37)	3.09 (0.67)	3.38 (0.58)	3.32 (0.56)	3.30 (0.70)		
Anthropometric characteristics									
Height	Medium	1,244.45 (68.90)	1,228.95 (57.56)	1,376.45 (50.39)	1,358.95 (70.25)	1,464.05 (73.39)	1,475.55 (77.30)	Group** Age** AgexSex**	ME > LP 7 < 9 < 11 9** 11*
	Low	1,233.65 (113.75)	1,207.25 (47.86)	1,350.48 (73.55)	1,294.58 (58.81)	1,402.68 (74.51)	1,458.87 (80.55)		
Weight	Medium	28.75 (6.52)	27.01 (5.90)	38.51 (8.87)	36.80 (10.89)	45.55 (9.83)	46.05 (10.16)	Group** Age**	ME > L 7 < 9 < 11
	Low	23.11 (3.33)	22.88 (3.20)	33.01 (7.76)	27.66 (6.48)	37.88 (11.34)	39.43 (12.52)		
Abdominal circumference	Medium	596.95 (75.78)	591.32 (77.95)	680.14 (91.13)	657.50 (99.76)	710.82 (104.60)	693.82 (89.44)	Group** Age** Sex*	ME> L 7 < 9 < 11 B > G
	Low	529.35 (24.91)	521.25 (35.79)	601.00 (89.90)	549.04 (72.18)	634.08 (97.49)	612.30 (98.27)		
Head circumference	Medium	516.77 (14.29)	506.23 (12.21)	529.18 (9.59)	518.59 (20.29)	530.64 (12.09)	526.41 (15.91)	Group** Age Sex	ME> L 7< 9 < 11 B > G
	Low	508.96 (15.22)	499.85 (16.42)	513.00 (19.80)	499.46 (22.55)	514.24 (16.08)	511.57 (16.77		

M, mean; SD, standard deviation; ME, medium; L, low; B, boy; G, girl; $^{**}p < 0.01$; $^{*}p < 0.05$.

TABLE 2 | Group, age, and sex differences and interaction on syndrome scales [Child Behavior Checklist (CBCL)].

Scales	Group	7 years		9 years		11 years		*p*	*Post hoc*
	Medium-SES (n = 133) Low-SES (n = 141)	**Boy (n = 45) M (SD)**	**Girl (n = 44) M (SD)**	**Boy (n = 45) M (SD)**	**Girl (n = 46) M (SD)**	**Boy (n = 47) M (SD)**	**Girl (n = 45) M (SD)**		
CBCL									
Anxiety	Medium	4.30 (3.43)	3.59 (3.47)	4.36 (3.35)	6.14 (4.12)	3.36 (3.35)	4.76 (2.43)	Group**	ME < L
	Low	4.96 (4.25)	5.90 (4.23)	4.65 (3.10)	5.50 (3.19)	6.56 (4.80)	6.57 (3.88)		
Depression	Medium	1.83 (1.80)	1.59 (2.22)	1.68 (1.67)	2.45 (2.41)	1.50 (1.74)	1.81 (1.75)	Group** AgexSex*	ME < L 9: B < G 11: B > G
	Low	2.48 (1.97)	3.70 (3.39)	3.09 (2.61)	4.50 (3.61)	5.52 (3.75)	3.61 (3.07)		
Somatic complaints	Medium	1.43 (1.67)	0.82 (1.30)	1.09 (1.38)	1.86 (1.96)	1.64 (2.38)	2.14 (2.03)	Group**	ME < L
	Low	2.65 (2.99)	3.25 (3.57)	2.39 (2.62)	2.79 (2.84)	3.60 (3.91)	2.91 (2.52)		
Social problems	Medium	2.26 (1.98)	3.00 (2.81)	2.27 (1.75)	3.59 (2.75)	1.77 (2.16)	2.43 (1.96)	Group**	ME < L
	Low	4.35 (3.54)	4.40 (2.98)	4.17 (3.23)	5.21 (3.16)	5.48 (3.45)	3.96 (2.95)		
Thought problems	Medium	1.43 (1.56)	1.23 (1.90)	1.05 (1.17)	1.64 (2.08)	1.23 (1.27)	0.67 (1.02)	AgexSex*	9: B < G 11: B > G
	Low	1.39 (1.90)	1.15 (1.90)	1.30 (1.33)	1.75 (2.38)	1.64 (1.76)	0.82 (1.40)		
Attention problems	Medium	370 (3.25)	2.95 (2.08)	2.45 (2.37)	3.27 (2.73)	3.45 (2.02)	2.95 (2.89)	Group**	ME < L
	Low	5.48 (3.32)	7.20 (4.54)	7.78 (5.63)	4.96 (5.39)	8.44 (5.79)	5.22 (3.90)		
Rule-breaking behavior	Medium	2.00 (1.48)	1.05 (1.56)	0.95 (1.13)	1.14 (1.83)	1.82 (1.82)	0.71 (0.85)	Group** Sex*	ME < L B > G
	Low	3.91 (4.37)	4.30 (3.64)	3.52 (4.08)	2.46 (1.82)	3.52 (3.58)	2.00 (2.32)		
Aggressive behavior	Medium	7.04 (5.05)	4.68 (4.19)	5.23 (4.48)	5.00 (3.68)	4.09 (3.07)	4.33 (1.96)	Group**	ME < L
	Low	9.09 (7.25)	9.55 (6.64)	11.78 (8.48)	8.46 (6.63)	10.76 (8.70)	10.13 (4.08)		

M, mean; SD, standard deviation; ME, medium; L, low; B, boy; G, girl; $^{**}p < 0.01$; $^{*}p < 0.05$.

TABLE 3 | Group, age, and sex differences and interaction on internalizing, externalizing, and total problems [Child Behavior Checklist (CBCL)].

Scales	Group	7 years		9 years		11 years		p	Post hoc
	Medium-SES (n = 133) Low-SES (n = 141)	**Boy (n = 45) M (SD)**	**Girl (n = 44) M (SD)**	**Boy (n = 45) M (SD)**	**Girl (n = 56) M (SD)**	**Boy (n = 47) M (SD)**	**Girl (n = 45) M (SD)**		
CBCL									
Internalizing problems	Medium	7.57 (4.50)	6.00 (4.67)	7.14 (5.29)	10.45 (6.88)	6.50 (5.40)	8.71 (4.42)	Group**	ME < L
	Low	10.09 (7.17)	12.85 (8.86)	10.13 (6.73)	12.79 (7.43)	15.68 (10.79)	13.09 (7.83)		
Externalizing problems	Medium	9.04 (5.67)	5.73 (5.33)	6.18 (5.05)	6.14 (4.85)	5.91 (4.56)	5.05 (3.37)	Group**	ME < L
	Low	13.00 (11.10)	13.85 (9.55)	15.30 (11.92)	10.92 (7.99)	14.28 (11.64)	12.13 (5.18)		
Total problems	Medium	28.96 (15.67)	22.95 (16.59)	23.55 (12.90)	30.23 (16.11)	23.41 (12.51)	23.29 (9.46)	Group**	ME < L
	Low	40.30 (23.47)	45.75 (22.60)	44.00 (24.94)	40.71 (22.62)	51.52 (27.61)	40.57 (15.27)		

*M, mean; SD, standard deviation; ME, medium; L, low; B, boy; G, girl; **p < 0.01.*

As shown in **Table 4** (CBCL social competence scales), the low-SES group obtained lower scores than the medium-SES group in social activities, F(1,253) = 12.114, p < .001 (partial $\eta^2 = .045$); school, F(1,256) = 64.122, p < .001 (partial $\eta^2 = .200$); and total social competence, F(1,249) = 35.289, p < .001 (partial $\eta^2 = .124$).

As shown in **Table 5** (CBCL DSM-oriented Scales), the low-SES group obtained higher scores than the medium-SES group in all problems except for anxiety and obsessive-compulsive disorder (OCD) problems, as follows: affective problems, F(1,258) = 36.531, p < .001 (partial $\eta^2 = .124$); somatic problems, F(1,258) = 14.155, p < .001 (partial $\eta^2 = .052$); ADHD problems, F(1,258) = 26.749 (partial $\eta^2 = .094$), p < .001; conduct problems, F(1,258) = 46.219, p < .001 (partial $\eta^2 = .152$); sluggish cognitive tempo (SCT) problems, F (1,258) = 23.543, p < .001 (partial $\eta^2 = .084$); and post-traumatic stress disorder (PTSD) problems, F(1,258) = 28.824, p < .001 (partial $\eta^2 = .100$).

Children were classified into three groups according to their T-score in each CBCL scale following proposals of the CBCL authors (34): a) no problems/normal, T-score < 65; b) borderline, typical score of 65–69; and c) clinical problems, T-score > 69. Children were also classified into three groups according to their scores in internalizing, externalizing, and total problem scales: a) no problems/normal, T-score < 60; b) borderline, T-score of 60–63; and c) clinical problems, T-score > 63. These results are exhibited in **Tables 6–8**, which report on the number of children in each group, the percentage, and the between-group differences evaluated using the chi-square test. In comparison to the medium-SES group, the low-SES group had a significantly and markedly higher percentage of children with clinical problems in all scales with the exception of anxiety and thought syndromes, DSM-oriented anxiety problems and OCD scales, and a significantly higher percentage of children with clinical internalizing (21.9 *vs.* 8.3%) and externalizing (18.5 *vs.* 2.6%) problems. These values were especially high for the depression scale (40.8 *vs.* 22.3%) (**Tables 6–8**).

Table 9 displays the results of simple linear regression models for the main CBCL variables (internalizing problems, externalizing problems, and total problems). All models showed statistically significant differences (p < .001) in all variables. The housing risk index (standardized $\beta = 0.204$, p = .005) and school competence (standardized $\beta = -0.214$, p = .001) emerged as a significant predictor of internalizing problems and school competence as a significant predictor of externalizing problems (standardized $\beta = -0.403$, p < .001) and total problems (standardized $\beta = -0.404$, p < .001).

TABLE 4 | Group, age, and sex differences and interaction on Social Competence Scales [Child Behavior Checklist (CBCL)].

Scales	Group	7 years		9 years		11 years		p	Post hoc
	Medium-SES (n = 133) Low-SES (n = 141)	**Boy (n = 45) M (SD)**	**Girl (n = 44) M (SD)**	**Boy (n = 45) M (SD)**	**Girl (n = 46) M (SD)**	**Boy (n = 47) M (SD)**	**Girl (n = 45) M (SD)**		
CBCL									
Activities	Medium	5.89 (2.95)	7.05 (3.00)	7.18 (1.94)	5.71 (2.94)	7.30 (2.44)	6.86 (2.31)	Group**	ME > L
	Low	5.39 (1.73)	5.37 (2.41)	5.30 (1.64)	6.57 (2.41)	6.00 (2.95)	6.04 (1.94)		
Social	Medium	5.26 (2.05)	5.23 (1.69)	5.62 (1.24)	4.82 (1.74)	5.30 (1.80)	5.57 (1.67)	Group**	ME > L
	Low	4.32 (2.23)	3.95 (1.96)	4.39 (2.04)	4.33 (1.79)	4.96 (1.95)	5.00 (2.28)		
School	Medium	5.22 (0.45)	5.05 (0.59)	5.09 (0.43)	5.18 (0.59)	5.13 (0.71)	5.19 (0.60)	Group**	ME > L
	Low	4.65 (0.93)	4.70 (0.86)	4.13 (0.87)	4.30 (1.11)	3.88 (1.05)	4.65 (0.65)		
Total social competence	Medium	16.59 (4.07)	17.86 (4.17)	18.57 (2.06)	16.00 (4.25)	17.95 (3.90)	17.81 (3.45)	Group**	ME > L
	Low	14.68 (2.93)	14.16 (3.64)	14.17 (2.98)	14.95 (3.30)	15.13 (3.96)	15.87 (3.61)		

*M, mean; SD, standard deviation; ME, medium; L, low; B, boy; G, girl; **p < 0.01.*

TABLE 5 | Group, age, and sex differences and interaction on Diagnostic and Statistical Manual (DSM)-oriented scales [Child Behavior Checklist (CBCL)].

Scales	Group	7 years		9 years		11 years		p	Post hoc
	Medium-SES (n = 133) Low-SES (n = 141)	Boy (n = 45) M (SD)	Girl (n = 44) M (SD)	Boy (n = 45) M (SD)	Girl (n = 46) M (SD)	Boy (n = 47) M (SD)	Girl (n = 45) M (SD)		
CBCL									
Affective problems	Medium	1.61 (1.83)	2.18 (2.40)	1.32 (1.52)	2.59 (2.70)	1.95 (1.50)	1.71 (1.45)	Group**	ME < L
	Low	3.17 (2.46)	3.85 (2.94)	3.52 (2.56)	3.75 (2.80)	5.04 (3.96)	3.13 (2.53)	AgexSex*	9: B < G
									11: B > G
Anxiety problems	Medium	3.04 (2.48)	2.55 (2.32)	2.95 (2.26)	4.09 (2.81)	2.09 (2.09)	3.29 (1.79)		
	Low	3.52 (2.48)	2.95 (2.19)	2.57 (2.54)	3.63 (2.20)	3.60 (2.71)	3.95 (2.92)		
Somatic problems	Medium	0.70 (0.88)	0.41 (0.80)	0.64 (0.90)	0.95 (1.76)	0.86 (1.49)	1.19 (1.54)	Group**	ME < L
	Low	1.43 (2.27)	1.85 (2.13)	1.04 (1.64)	1.46 (1.91)	1.92 (2.52)	2.00 (2.49)		
ADHD problems	Medium	4.57 (3.98)	3.59 (3.11)	3.00 (2.20)	4.18 (3.35)	3.95 (2.50)	2.86 (3.31)	Group**	ME < L
	Low	6.13 (3.36)	6.60 (4.08)	6.74 (4.21)	4.17 (3.42)	6.44 (4.32)	5.30 (3.34)		
Oppositionalproblems	Medium	3.09 (2.48)	2.23 (2.02)	1.91 (2.04)	2.00 (1.85)	1.82 (1.74)	1.29 (1.49)	Group**	ME < L
	Low	3.13 (2.83)	3.60 (3.05)	4.17 (3.26)	2.75 (2.63)	3.88 (3.33)	3.35 (1.67)		
Conduct problems	Medium	1.91 (1.47)	1.00 (1.48)	0.95 (1.36)	0.95 (1.68)	1.82 (2.15)	0.76 (0.77)	Group**	ME < L
	Low	4.65 (5.77)	5.05 (4.49)	4.74 (5.99)	3.08 (2.90)	4.44 (4.93)	2.83 (2.81)		
SCT	Medium	0.57 (1.12)	0.68 (0.89)	0.36 (0.66)	1.00 (1.31)	0.55 (0.96)	0.71 (0.96)	Group**	ME < L
	Low	0.78 (1.41)	1.50 (1.88)	2.00 (2.49)	1.96 (2.49)	2.24 (2.37)	1.26 (1.60)		
OCD	Medium	1.61 (1.90)	1.23 (1.57)	1.77 (2.20)	1.95 (2.15)	1.14 (1.32)	1.43 (1.33)	GroupxAge*	9: ME > L
	Low	1.35 (1.37)	1.55 (1.61)	1.26 (1.18)	1.13 (1.42)	2.36 (2.25)	1.74 (1.60)		11: ME < L
PTSD	Medium	4.26 (2.96)	3.18 (2.34)	4.32 (3.08)	5.18 (3.39)	2.77 (1.77)	3.81 (2.09)	Group**	ME < L
	Low	5.65 (3.82)	6.00 (3.28)	5.48 (4.52)	6.38 (4.57)	7.92 (5.26)	6.35 (4.14)	GroupxAge*	7: ME < L
									9: ME = L
									11: ME < L

M, mean; SD, standard deviation; ME, medium; L, low; B, boy; G, girl; SCT, sluggish cognitive tempo; OCD, obsessive-compulsive disorder; PTSD, post-traumatic stress disorder; **$p < 0.01$; *$p < 0.05$.

TABLE 6 | Percentages of children with and without clinical problems in Syndrome scales [Child Behavior Checklist (CBCL)] and analysis of differences between medium- and low-socioeconomic status (SES) groups.

Scales	Group					
	Medium-SES (n = 133) Low-SES (n = 141)	Without problem n (%)	Borderline n (%)	Clinical n (%)	χ^2	p
Anxiety	Medium	104 (32.9%)	15 (5.7%)	8 (3%)	4.962	0.084
	Low	97 (36.6%)	25 (9.4%)	16 (6%)		
Depression	Medium	53 (20%)	15 (5.7%)	59 (22.3%)	28.749	<0.001**
	Low	24 (9.1%)	6 (2.3%)	108 (40.8%)		
Somatic complaints	Medium	115 (43.4%)	10 (3.8%)	2 (0.8%)	13.910	0.001**
	Low	103 (38.9%)	19 (6%)	16 (6%)		
Social problems	Medium	119 (44.9%)	5 (1.9%)	3 (1.1%)	13.967	0.001**
	Low	107 (40.4%)	16 (6%)	15 (5.7%)		
Thought problems	Medium	124 (46.8%)	2 (0.8%)	1 (0.4%)	2.758	0.252
	Low	129 (48.7%)	7 (2.6%)	2 (0.8%)		
Attention problems	Medium	122 (46%)	5 (1.9%)	0 (0%)	33.869	<0.001**
	Low	96 (36.2%)	19 (7.2%)	23 (8.7%)		
Rule-breaking behavior	Medium	124 (46.8%)	2 (0.8%)	1 (0.4%)	26.490	<0.001**
	Low	105 (39.6%)	12 (4.5%)	21 (7.9%)		
Aggressive behavior	Medium	118 (44.5%)	7 (2.6%)	2 (0.8%)	32.973	<0.001**
	Low	89 (33.6%)	22 (8.3%)	27 (10.2%)		

**$p < 0.01$.

DISCUSSION

This study examined the impact of a low SES on the psychopathology of children living in a developing country, considering three age groups (7, 9, and 11 years). In comparison to children in a medium-SES environment, those in a low-SES environment had more internalizing and externalizing problems, with a higher prevalence of most

TABLE 7 | Percentages of children with and without clinical problems in internalizing, externalizing, and total problem scales [Child Behavior Checklist (CBCL)] and analysis of differences between medium- and low-socioeconomic status (SES) groups.

Scales	Group					
	Medium-SES (n = 133) Low-SES (n = 141)	**Without problem n (%)**	**Borderline n (%)**	**Clinical n (%)**	**χ^2**	***p***
Internalizing problems	Medium	86 (32.5%)	19 (7.2%)	22 (8.3%)	19.696	<0.001**
	Low	62 (23.4%)	18 (6.8%)	58 (21.9%)		
Externalizing problems	Medium	106 (40%)	14 (5.3%)	7 (2.6%)	36.416	<0.001**
	Low	75 (28.3%)	14 (5.3%)	49 (18.5%)		
Total problems	Medium	104 (32.9%)	17 (6.4%)	6 (2.3%)	40.456	<0.001**
	Low	68 (25.7%)	22 (8.3%)	48 (18.1%)		

***p < 0.01.*

TABLE 8 | Percentages of children with and without clinical problems in Diagnostic and Statistical Manual (DSM)-oriented scales [Child Behavior Checklist (CBCL)] and analysis of differences between medium- and low-socioeconomic status (SES) groups.

Scales	Group					
	Medium-SES (n = 133) Low-SES (n = 141)	**Without problem n (%)**	**Borderline n (%)**	**Clinical n (%)**	**χ^2**	***p***
Affective problems	Medium	113 (42.6%)	11 (4.2%)	3 (1.1%)	17.868	<0.001**
	Low	97 (36.6%)	18 (6.8%)	23 (8.7%)		
Anxiety problems	Medium	87 (32.8%)	19 (7.2%)	21 (7.9%)	1.519	0.468
	Low	89 (33.6%)	18 (6.8%)	31 (11.7%)		
Somatic problems	Medium	119 (44.9%)	5 (1.9%)	3 (1.1%)	10.722	0.005**
	Low	111 (41.9%)	12 (4.5%)	15 (5.7%)		
ADHD problems	Medium	113 (42.6%)	10 (3.8%)	4 (1.5%)	18.280	<0.001**
	Low	94 (35.5%)	22 (8.3%)	22 (8.3%)		
Oppositional problems	Medium	115 (43.4%)	9 (3.4%)	3 (1.1%)	17.372	<0.001**
	Low	105 (39.6%)	8 (3%)	25 (9.4%)		
Conduct problems	Medium	123 (46.4%)	4 (1.5%)	0 (0%)	39.445	<0.001**
	Low	93 (35.1%)	20 (7.5%)	25 (9.4%)		
SCT	Medium	119 (44.9%)	4 (1.5%)	4 (1.5%)	18.785	<0.001**
	Low	103 (38.9%)	9 (3.4%)	26 (9.8%)		
OCD	Medium	118 (44.5%)	3 (1.1%)	6 (2.3%)	3.966	0.138
	Low	134 (50.6%)	0 (0%)	4 (1.5%)		
PTSD	Medium	119 (44.9%)	6 (2.3%)	2 (0.8%)	22.061	<0.001**
	Low	99 (37.4%)	25 (9.4%)	14 (5.3%)		

*SCT, sluggish cognitive tempo; OCD, obsessive-compulsive disorder; PTSD, post-traumatic stress disorder **p < 0.01.*

syndromes studied and lower scores in social competence skills. A larger percentage of children in the low- *versus* medium-SES group had clinical problems in scales related to internalizing and externalizing problems. Finally, the housing risk index and school competence were the two main predictors of internalizing and externalizing problems in this population.

Higher scores were obtained by the low- *versus* medium-SES group in the three CBCL psychopathology scales (externalizing, internalizing, and total problems). According to the present findings, this type of problem remains present at the ages of 7, 9, and 11 years old in children with low SES, with negative effects on all psychopathological functions and an evident presence of emotional problems. It has also been suggested that malnourished children are more likely to suffer from post-traumatic stress, chronic fatigue syndrome, and depression, among other psychopathological manifestations (38).

In line with the results of previous studies, not all SES factors were associated with the emergence of emotional problems to the same degree (14, 25). The factors that best predicted the presence of emotional problems in our study were the housing risk indicator and school competence deficits. The remaining variables did not demonstrate a significant relationship, although a non-significant trend was observed for the social class of the head of the household. We highlight that the educational level of the mother was not related to the risk of emotional problems in our regression model, which may be attributable to the similarly low educational level of the mothers in both low- and medium-SES groups.

The children in the low-SES group were much more vulnerable to internalizing and externalizing clinical problems in comparison to those in the medium-SES group, and a large proportion of them suffered from clinical depressive disorders.

TABLE 9 | Linear regression models using score for internalizing, externalizing, and total problems as criteria and sex, age variables, socioeconomic status (SES) dimensions, and social competences as predictor.

Scales	Variables	Standardized β	*t*	*p*	Inferior 95% CI	Superior 95% CI	F model	R^2	Adjusted R^2
Internalizing problems							F(8, 253) = 5.962***	.163	.136
	Age	0.084	1.406	0.161	–0.156	0.937			
	Sex	0.098	1.656	0.099	–0.279	3.220			
	MLE	–0.048	–0.634	0.527	–1.111	0.570			
	HRI	0.204	2.862	0.005**	0.942	5.101			
	SCL	0.143	1.819	0.070	–0.093	2.334			
	Activities	0.002	0.026	0.979	–0.375	0.385			
	Social	0.061	0.959	0.339	–0.248	0.718			
	School	–0.214	–3.317	0.001**	–2.941	–0.750			
Externalizing problems							F(8,253) = 9.251***	0.232	0.207
	Age	–0.094	–1.647	0.101	–1.094	0.098			
	Sex	–0.054	–0.960	0.338	–2.838	0.977			
	MLE	–0.043	–0.589	0.556	–1.191	0.643			
	HRI	0.089	1.311	0.191	–0.759	3.777			
	SCL	0.116	1.542	0.124	–0.287	2.360			
	Activities	–0.025	–0.412	0.681	–0.501	0.328			
	Social	–0.008	–0.125	0.900	–0.561	0.493			
	School	–0.0403	–6.529	<0.001***	–5.157	–2.767			
Total problems							F(8,253) = 11.768***	0.278	0.254
	Age	–0.040	–0.721	0.472	–1.959	0.909			
	Sex	0.006	0.115	0.908	–4.321	4.858			
	MLE	–0.043	–0.605	0.546	–2.883	1.528			
	HRI	0.170	2.567	0.011*	1.656	12.568			
	SCL	0.153	2.092	0.037*	0.198	6.566			
	Activities	–0.017	–0.297	0.767	–1.147	0.847			
	Social	0.074	1.251	0.212	–0.463	2.073			
	School	–0.404	–6.736	<0.001***	–12.709	–6.958			

MLE, maternal level of education; HRI, Housing Risk Index; SCL, social class level of head of household, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Among previous studies on the risk of low SES for the mental health of children and adolescents, some found that the SES had a greater impact on externalizing disorders (31), whereas we found a generalized association with all problems as well as social competence.

In comparison to the medium-SES group, a greater effect size was observed for the sub-scales related to externalizing behavior in the low-SES group. Previous studies have shown that toxins, ambient noise, and neighbor quality, among many other environmental conditions, are associated with a larger number of these types of problem, including impaired impulse control and higher levels of aggression (15).

Finally, although the children under study had no previous diagnosis of psychological or cognitive impairment, the results for the low-SES group showed very high values in subscales for depression and aggressive behavior, among others. As previously reported (30), it appears to be difficult to correctly identify severe externalizing and internalizing symptoms in children, hampering their receipt of appropriate treatments or interventions.

The present data underline the need for early interventions in infancy to reduce mental health problems among children and adolescents in situations of chronic poverty, as previously proposed (39–48). These should consider multiple aspects related to the well-being of children, including performance at school and housing conditions. It is also desirable to involve parents and to adjust interventions to the reality of family life in socially disadvantaged settings. Shonkoff, Richter, van der Gaag, and Bhutta (49) reviewed interventions designed to improve the survival and development of children with low SES and concluded that the combination of nutritional interventions and psychosocial stimulation was the most widely supported approach.

Given that this was not a longitudinal study, it was not possible to rule out the effect of other variables on the differences observed among the three age groups. Future longitudinal studies are needed to control the effect of the exposure to low-SES, as well as other central variables regarding the SES such as physical conditions at home, family income, and the perceived level of stress. A further limitation was the inability to differentiate among the effects on socio-emotional development of specific aspects of low-SES (e.g., poverty, malnutrition, infant abuse, etc.). However, we contribute the first report of this nature in a population of Ecuadorian children, and the results will help in the development of programs to screen for mental health problems in children in disadvantaged settings and to detect indicators of cognitive, emotional, and social vulnerability.

Investigation of the different factors underlying the relationship between a disadvantaged environment and mental health is beyond the scope of our study. Various hypotheses have been developed, including the benefits for learning of a more stimulating and protected environment (50) and the negative effects of a low SES on the development of brain circuits and metabolism-regulating systems, increasing the likelihood of long-term problems in learning, behavior, mental, and physical health (51). It has been observed that the experience of multiple social and economic stressors generates emotional problems related to fear and anxiety in young people, increasing disruptive behavior and alterations in executive function and self-regulation (52). Further research is warranted to elucidate these issues.

CONCLUSION

In conclusion, schoolchildren with low SES in a developing country had more emotional disorders, including externalizing and internalizing problems, in comparison to those with medium SES. Housing risk index and school competence emerged as the main predictors of the children's CBCL scores. These findings support the need for short-term and long-term preventive programs to counter the negative effects of social deprivation. Future research is required on emotional variables in children with low SES and on related aspects, including the influence of genetics and the role of specific brain mechanisms. It is of particular interest to determine whether the trend to a greater impact of low SES at higher age (11 *vs*. 7 years of age) detected in this study continues up to adulthood.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding authors.

ETHICS STATEMENT

Written consent was obtained from the parents/guardians of the children for their participation in the study, which was approved by the ethical committee of the local University (Ref: A3/042954/11).

AUTHOR CONTRIBUTIONS

MNP-M, CB-G, FC-Q, and MP-G designed the tasks and collected the data. MNP-M, MF-A, AF, and CB-G undertook the statistical analysis, and MNP-M wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

FUNDING

This study was supported by the Spanish Agency for International Development Cooperation (AECID) [A3/042954/11] (PI: FC-Q) and Conselleria d'Educació, Investigació, Cultura I Esport de la Generalitat Valenciana (R+D+i projects developed by emerging research groups) [GV/2017/166] (PI: MF-A).

ACKNOWLEDGMENTS

The authors are grateful to Richard Davies and Layla Davies-Jiménez for assistance with the English version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

SYSTEMATIC REVIEW
published: 18 February 2020
doi: 10.3389/fpsyt.2019.00933

Psychological and Psychosocial Interventions for PTSD, Depression and Anxiety Among Children and Adolescents in Low- and Middle-Income Countries: A Meta-Analysis

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OPEN ACCESS

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Specialty section:
This article was submitted to
Child and Adolescent Psychiatry,
a section of the journal
Frontiers in Psychiatry

Received: *15 July 2019*
Accepted: *25 November 2019*
Published: *18 February 2020*

Citation:
Uppendahl JR, Alozkan-Sever C, Cuijpers P, de Vries R and Sijbrandij M (2020) Psychological and Psychosocial Interventions for PTSD, Depression and Anxiety Among Children and Adolescents in Low- and Middle-Income Countries: A Meta-Analysis. Front. Psychiatry 10:933. doi: 10.3389/fpsyt.2019.00933

Background: In low- and middle-income countries, rates of common mental health disorders are found to be very high among children and adolescents while individuals, particularly in these countries, face barriers to mental health care. In the recent years, randomized controlled trials (RCTs) have been conducted that implemented and tested different psychological and psychosocial treatment approaches to treat common mental disorders. This review aims to analyze psychological interventions among children and adolescents in low- and middle-income countries.

Methods: RCTs carried out in low- and middle-income countries on psychological and psychosocial interventions for children and adolescents with symptoms of trauma- and stressor related disorders, depression or anxiety were identified in bibliographic databases. Databases were systematically searched until December 14, 2018. Effect sizes indicating differences between treatment and control groups at post-test were computed using a random-effects model. Outcomes were symptoms of depression, anxiety and posttraumatic stress disorder (PTSD).

Results: Thirteen studies with a total of 2,626 participants aged between 5 and 18 years were included. Treatments varied between studies and number of treatment sessions ranged from 1 to 16. The pooled effect size, combining outcomes of depression, anxiety and PTSD of psychological or psychosocial intervention versus care-as-usual or a control conditions yielded a medium effect (g = 0.62; 95% CI: 0.27–0.98). Heterogeneity was very high (I^2 = 94.41; 95% *CI* = 80–91). The beneficial effect of interventions increased after excluding outliers (g = 0.72; 95% *CI*: 0.37–1.07), while heterogeneity remained high (I^2 = 86.12; 95% *CI* = 87–94).

Conclusion: High quality RCTs investigating the effect of psychological and psychosocial interventions on PTSD, depression and anxiety among children and adolescents in low- and middle-income countries are scarce. Results of the available studies may suggest that psychological and psychosocial interventions might be more effective in reducing symptoms of anxiety, depression and PTSD compared to control conditions. Due to very high heterogeneity, this evidence must be considered with caution.

Keywords: low- and middle- income countries, children, adolescents, posttraumatic stress disorder, depression, anxiety, meta-analysis, psychological therapy

INTRODUCTION

Approximately one third of the total population in low- and middle-income countries are children and adolescents aged below 18 (1). Future projections see a world population shift towards an older age structure (2). Currently many western countries already face high old age dependency ratios, while many low-income countries, are considered as regions with a high "child dependency ratio," among them most sub-Saharan African countries and parts of Asia. This means that here there are more than 45 children per 100 working age individuals (ages 15 to 64) (2). These individuals, being the majority of the world's children and adolescents, receive on average less than US$0.01 assistance for mental health (3). Yet, prevalence estimates for youth in low- and middle-income countries range from 8–27% for anxiety symptoms, 0–28% for depressive symptoms, and for posttraumatic stress disorder (PTSD) estimates range from 0.2% to as high as 87% in adolescents who experienced traumatic events (4). Furthermore, results from the Global Burden of Disease study 2013 reveal that for children and adolescents aged 10 to 19, depressive disorders are one of the leading causes of years lived with disability (5).

When comparing prevalence rates of children and adolescents in high income countries to those in low- and middle-income countries, often a large variability has been found which has largely been attributed to methodological limitations, such as that diagnostic categories often have been developed and tested in high income countries (6). These issues impose problems when comparing prevalence rates across societies (6–8).

A number of trials have been conducted to investigate the effect of psychological and psychosocial interventions. In high income countries, psychotherapies have been found to be effective in treating common mental disorders (9, 10). In low- and middle-income countries studies focusing on adult populations have shown that psychological therapies can reduce symptoms of PTSD, depression and anxiety (11). Considering the effectiveness of psychological and psychological interventions for children and adolescents in low- and middle-income settings, meta-analyses which evaluate the evidence of RCTs examining these interventions are still lacking.

The trials that have been conducted with children and adolescents implemented various forms of psychological and psychosocial treatments, such as school-based treatments, parent- and family-focused interventions, psychoeducational and/or supportive interventions, all of which can include components of cognitive behavioral and exposure based techniques, expressive techniques and mind–body oriented skills (12). Although recommendations advise adjusting an intervention to its target group by making cultural adaptions, these are not commonly implemented or are poorly reported (11, 13, 14).

The majority of the reviews that have previously been conducted to test which of these psychological treatments are most effective focused on children and adolescents who witnessed or experienced adverse events through war or humanitarian crisis (11, 13, 15, 16). However, these reviews did not take into account the general population of children and adolescent in low-and middle-income countries. Singla et al. (17) Klasen and Crombag (18) Yatham et al. (4) and Pedersen et al. (19) performed systematic reviews on interventions for youth in low- and middle-income countries, however, these reviews were not conducted as a meta-analysis, therefore, results were not reported with statistical evidence. Likewise, Purgato et al. (12) analyzed focused psychosocial interventions for children in low-resource humanitarian settings. This review was performed as an individual patient data meta-analysis in a limited target group. Results showed a small positive effect of focused psychosocial interventions on PTSD symptoms but not for depression and anxiety (11).

To our knowledge no recent meta-analysis is currently available that provides results of psychological and psychosocial treatments for children and adolescents in low- and middle-income countries for symptoms of common mental health disorders. This meta-analysis aims to review the effectiveness of psychological and psychosocial interventions for children and adolescents that are focused on the treatment of trauma- and stressor related disorders and depression and anxiety in low- and middle-income countries.

METHODS

Eligibility Criteria

The present review was registered on PROSPERO under the following ID: CRD42019111558. No specific funding was available for this review (20).

Types of Studies

In accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) we predefined our research question in regards to Population, Intervention, Comparison, Outcome and Study (PICOS) **Table 1** (21). We included studies that were conducted as randomized controlled trials (RCTs) or cluster randomized controlled trials (cRCTs) in a low- middle-income country as defined by the World Bank (22).

TABLE 1 | PRISMA checklist.

Section/topic	#	Checklist item	Reported on page #
Title			
Title	1	Identify the report as a literature review.	1
Abstract			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings;	1
Introduction			
Rationale	3	Describe the rationale for the review in the context of what is already known about your topic.	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	2
Methods			
Eligibility criteria	5	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	2; 3
Information sources	6	Describe all information sources (e.g., databases with dates of coverage) in the search and date last searched.	3
Search	7	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	8-10
Study selection	8	State the process for selecting studies (i.e., screening, eligibility).	4
Risk of bias in individual studies	9	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level).	3
Risk of bias across studies	10	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4; 5
Results			
Study selection	11	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	4
Study characteristics	12	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	4
Synthesis of results of individual studies	13	For all outcomes considered (benefits or harms), present, for each study: (a) summary of results and (b) relationship to other studies under review (e.g. agreements or disagreements in methods, sampling, data collection or findings).	5
Discussion			
Summary of evidence	14	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	5-7; 8; 10; 12
Limitations	15	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	7-8
Conclusion			
Conclusions	16	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	12

Studies had to implement a psychological intervention and an active or non-active comparison group had to be included.

Types of Participants

We included children and adolescents below the age of 18 who met diagnostic criteria for any of the anxiety, depressive disorders and/or trauma- and stressor-related disorders (as classified by DSM-5) based on a clinical diagnostic interview or scored above a specified cut-off on a self-report instrument (23). Furthermore, children and adolescents had to be living in low- and middle-income countries defined by the World Bank.

Types of Outcome Measures

As outcomes we defined measures of symptoms of anxiety, depression or symptoms of PTSD measure by an interview or self-report instrument.

Procedure

Identification of Studies

A review protocol was developed based on the PRISMA-statement. A comprehensive search was performed in the bibliographic databases PubMed, Embase.com, and EBSCO/PsycINFO, in collaboration with a medical librarian. Databases were searched from inception until December 14, 2018. The following terms were used as index terms or free-text words (including synonyms and closely related words):

"Developing countries," "Low- and middle-income countries," "Anxiety disorders," "Depressive disorders," "Children," and "Adolescents." The search was performed without restrictions on date, language or publication status. Duplicate articles were excluded. The complete search strings for all databases can be found in **Table 2**–**4**. Titles and abstracts were screened by one author based on pre-defined inclusion criteria. The full-texts were then retrieved from the selected studies and rated by two authors. Data then was extracted from the included studies.

Data Extraction

Data was extracted on an Excel sheet by two independent researchers. Information on study design, country, assessment instrument, blinding of assessors, type of comparison, type of therapy, treatment provider, fidelity assessment, theoretical

TABLE 2 | Search string PubMed session results (14 Dec 2018).

Search	Query	Items found
#5	#1 AND #2 AND #3 AND #4	928
#4	clinical trial*[tw] OR controlled trial*[tw] OR random*[tw] OR psycho-social intervention*[tiab] OR psychosocial intervention*[tiab] OR psychological intervention*[tiab] OR psychologic intervention*[tiab]	1,833,474
#3	child*[tw] OR adolescen*[tw] OR pediatric*[tw] OR paediatric*[tw] OR pube*[tw] OR juvenil*[tw] OR youngster*[tiab] OR kid[tiab] OR kids[tiab] OR prepube*[tiab] OR preadolescen*[tiab] OR young people*[tiab] OR minors[tiab] OR youth*[tiab] OR teen[tiab] OR teens[tiab] OR teenager*[tiab]	3,448,709
#2	"Anxiety Disorders"[Mesh] OR "Trauma and Stressor Related Disorders"[Mesh] OR "Depressive Disorder"[Mesh] OR "Depression"[Mesh] OR "Panic"[Mesh] OR "Mutism"[Mesh] OR anxiety[tiab] OR panic[tiab] OR phobic[tiab] OR phobia[tiab] OR stressor[tiab] OR post-traumatic[tiab] OR posttraumatic[tiab] OR traumatic stress[tiab] OR psychological trauma*[tiab] OR depress*[tiab] OR dysthymi*[tiab] OR dysthimi*[tiab] OR dysphori*[tiab] OR selective mutism*[tiab] OR elective mutism*[tiab]	654,463
#1	"Developing Countries"[Mesh] OR developing countr*[tiab] OR developing nation*[tiab] OR developing population*[tiab] OR developing econom*[tiab] OR undeveloped countr*[tiab] OR undeveloped nation*[tiab] OR "undeveloped economy"[tiab] OR "undeveloped economies"[tiab] OR least developed countr*[tiab] OR least developed nation*[tiab] OR "least developed economy"[tiab] OR "least developed economies"[tiab] OR less-developed countr*[tiab] OR less-developed nation*[tiab] OR "less-developed population"[tiab] OR "less-developed populations"[tiab] OR less-developed econom*[tiab] OR lesser developed countr*[tiab] OR lesser developed nation*[tiab] OR "lesser developed population"[tiab] OR "lesser developed populations"[tiab] OR "lesser developed economy"[tiab] OR "lesser developed economies"[tiab] OR under-developed countr*[tiab] OR under-developed nation*[tiab] OR underdeveloped countr*[tiab] OR underdeveloped nation*[tiab] OR underdeveloped population*[tiab] OR underdeveloped econom*[tiab] OR low income countr*[tiab] OR middle income countr*[tiab] OR low income nation*[tiab] OR middle income nation*[tiab] OR low income population*[tiab] OR middle income population*[tiab] OR low income econom*[tiab] OR middle income econom*[tiab] OR lower income countr*[tiab] OR lower income nation*[tiab] OR lower income population*[tiab] OR "lower income economy"[tiab] OR "lower income economies"[tiab] OR resource limited[tiab] OR low resource countr*[tiab] OR lower resource countr*[tiab] OR low resource nation*[tiab] OR low resource population*[tiab] OR "low resource economy"[tiab] OR "low resource economies"[tiab] OR underserved countr*[tiab] OR underserved nation*[tiab] OR underserved population*[tiab] OR "underserved economy"[tiab] OR "underserved economies"[tiab] OR "under-served country"[tiab] OR "under-served countries"[tiab] OR "under-served nation"[tiab] OR "under-served nations"[tiab] OR "under-served population"[tiab] OR "under-served populations"[tiab] OR "underserved economy"[tiab] OR "underserved economies"[tiab] OR "deprived country"[tiab] OR "deprived countries"[tiab] OR "deprived nation"[tiab] OR "deprived nations"[tiab] OR "deprived population"[tiab] OR "deprived populations"[tiab] OR "deprived economy"[tiab] OR "deprived economies"[tiab] OR poor countr*[tiab] OR poor nation*[tiab] OR poor population*[tiab] OR poor econom*[tiab] OR poorer countr*[tiab] OR poorer nation*[tiab] OR poorer population*[tiab] OR poorer econom*[tiab] OR lmic[tiab] OR lmics[tiab] OR lami[tiab] OR transitional countr*[tiab] OR "transitional nation"[tiab] OR "transitional nations"[tiab] OR transitional econom*[tiab] OR transition countr*[tiab] OR transition nation*[tiab] OR transition econom*[tiab] OR low resource setting*[tiab] OR lower resource setting*[tiab] OR middle resource setting*[tiab] OR Third World*[tiab] OR south east asia*[tw] OR middle east*[tw] OR Afghan*[tw] OR Angola*[tw] OR Angolese*[tw] OR Angolian*[tw] OR Armenia*[tw] OR Bangladesh*[tw] OR Benin*[tw] OR Bhutan*[tw] OR Birma*[tw] OR Burma*[tw] OR Birmese*[tw] OR Burmese*[tw] OR Boliv*[tw] OR Botswan*[tw] OR burkina Faso*[tw] OR Burundi*[tw] OR Cabo Verde*[tw] OR Cambod*[tw] OR Cameroon*[tw] OR Cape Verd*[tw] OR Central Africa*[tw] OR Chad[tw] OR Comoro*[tw] OR Congo*[tw] OR Cote d'Ivoire*[tw] OR Djibouti*[tw] OR East Africa*[tw] OR Eastern Africa*[tw] OR Egypt*[tw] OR El Salvador*[tw] OR Equatorial Guinea*[tw] OR Eritre*[tw] OR Ethiopia*[tw] OR Gabon*[tw] OR Gambia*[tw] OR Gaza*[tw] OR "Georgia (Republic)"[Mesh] OR Ghan*[tw] OR Guatemal*[tw] OR Guinea[tw] OR Haiti*[tw] OR Hondur*[tw] OR India*[tw] OR Indones*[tw] OR Ivory Coast*[tw] OR Kenya*[tw] OR Kiribati*[tw] OR Kosovo*[tw] OR Kyrgyz*[tw] OR Lao PDR*[tw] OR Laos*[tw] OR Lesotho*[tw] OR Liberia*[tw] OR Madagascar*[tw] OR Malaw*[tw] OR Mali[tw] OR Mauritan*[tw] OR Mauriti*[tw] OR Micronesi*[tw] OR Mocambiqu*[tw] OR Moldov*[tw] OR Mongolia*[tw] OR Morocc*[tw] OR Mozambiqu*[tw] OR Myanmar*[tw] OR Namibia*[tw] OR Nepal*[tw] OR Nicaragua*[tw] OR Niger*[tw] OR North Korea*[tw] OR Northern Korea*[tw] OR (Democratic[tiab] AND People*[tiab] AND Republic of Korea[tiab]) OR "Democratic People's Republic of Korea"[Mesh] OR Pakistan*[tw] OR Papua New Guinea*[tw] OR Philippine*[tw] OR Principe[tw] OR Rhodesia*[tw] OR Rwanda*[tw] OR Samoa*[tw] OR Sao Tome*[tw] OR Senegal*[tw] OR Sierra Leone*[tw] OR Solomon Islands*[tw] OR Somalia*[tw] OR South Africa*[tw] OR South Sudan*[tw] OR Southern Africa*[tw] OR Sri Lanka*[tw] OR Sub Saharan Africa*[tw] OR Subsaharan Africa*[tw] OR Sudan*[tw] OR Swaziland*[tw] OR Syria*[tw] OR Tajikist*[tw] OR Tanzan*[tw] OR Timor*[tw] OR Togo*[tw] OR Tonga*[tw] OR Tunis*[tw] OR Ugand*[tw] OR Ukrain*[tw] OR Uzbekistan*[tw] OR Vanuatu*[tw] OR Vietnam*[tw] OR West Africa*[tw] OR West Bank*[tw] OR Western Africa*[tw] OR Yemen*[tw] OR Zaire*[tw] OR Zambia*[tw] OR Zimbabw*[tw]	937,841

background, duration of therapy, number of sessions and format of therapy, in- and exclusion criteria of participants, number of participants, gender, mean age, standard deviation and age range of participants, pre-treatment, post-treatment and follow-up assessment means standard deviations or mean differences and standard deviations of change scores for both intervention and control groups were recorded. Discrepancies were discussed and resolved.

Quality Assessment

Quality of studies was assessed by two independent reviewers. Version 2 of the Cochrane risk-of-bias tool (RoB 2) was used to perform quality assessment (24). Randomized controlled trials were assessed with RoB 2 for randomized controlled trials, and cluster randomized controlled trials were respectively assessed with RoB 2 for cluster randomized controlled trials. In both, assessments studies were evaluated on the following paradigms: Bias arising from the randomization process; bias arising from the timing of identification and recruitment of individual participants in relation to randomization; bias due to deviations from intended interventions; bias due to missing outcome data; bias in measurement of the outcome, and bias in selection of the reported result. All paradigms inherit specific questions concerning the study that are answered with either "yes," "probably yes," "no," "probably no" or "no information." These questions guide the decision to evaluate a paradigm, and therewith, the risk of bias in a study with either "low risk," "some concerns" or "high risk." The Cochrane tool provides an

TABLE 3 | Search string embase.com session results (14 Dec 2018).

Search	Query	Items found
#5	#1 AND #2 AND #3 AND #4	1,088
#4	'clinical trial'/exp OR 'clinical trial*':ab,ti,kw OR 'controlled trial*':ab,ti,kw OR random*:ab,ti,kw OR 'psychosocial intervention*':ab,ti,kw OR 'psycho-social intervention*':ab,ti,kw OR 'psychological intervention*':ab,ti,kw OR 'psychologic intervention*':ab,ti,kw	2,436,080
#3	'child'/de OR 'adolescent'/de OR child*:ab,ti,kw OR adolescen*:ab,ti,kw OR pediatric*:ab,ti,kw OR paediatric*:ab,ti,kw OR pube*:ab,ti,kw OR juvenil*:ab,ti,kw OR youngster*:ab,ti,kw OR kid:ab,ti,kw OR kids:ab,ti,kw OR prepube*:ab,ti,kw OR preadolescen*:ab,ti,kw OR 'young people*':ab,ti,kw OR minors:ab,ti,kw OR youth*:ab,ti,kw OR teen:ab,ti,kw OR teens:ab,ti,kw OR teenager*:ab,ti,kw	3,463,670
#2	'anxiety disorder'/exp OR 'depression'/exp OR 'selective mutism'/exp OR anxiety:ab,ti,kw OR panic:ab,ti,kw OR phobic:ab,ti,kw OR phobia:ab,ti,kw OR stressor:ab,ti,kw OR 'post-traumatic':ab,ti,kw OR posttraumatic:ab,ti,kw OR 'traumatic stress':ab,ti,kw OR 'psychological trauma*':ab,ti,kw OR depress*:ab,ti,kw OR dysthymi*:ab,ti,kw OR dysthimi*:ab,ti,kw OR dysphori*:ab,ti,kw OR 'selective mutism*':ab,ti,kw OR 'elective mutism*':ab,ti,kw	986,338
#1	'developing country'/exp OR 'low income country'/exp OR 'middle income country'/exp OR 'developing countr*':ab,ti,kw OR 'developing nation*':ab,ti,kw OR 'developing population*':ab,ti,kw OR 'developing econom*':ab,ti,kw OR 'undeveloped countr*':ab,ti,kw OR 'undeveloped nation*':ab,ti,kw OR 'undeveloped econom*':ab,ti,kw OR 'least developed countr*':ab,ti,kw OR 'least developed nation*':ab,ti,kw OR 'least developed econom*':ab,ti,kw OR 'less-developed countr*':ab,ti,kw OR 'less-developed nation*':ab,ti,kw OR 'less-developed population*':ab,ti,kw OR 'less-developed econom*':ab,ti,kw OR 'lesser developed countr*':ab,ti,kw OR 'lesser developed nation*':ab,ti,kw OR 'lesser developed population*':ab,ti,kw OR 'lesser developed econom*':ab,ti,kw OR 'under-developed countr*':ab,ti,kw OR 'under-developed nation*':ab,ti,kw OR 'underdeveloped countr*':ab,ti,kw OR 'underdeveloped nation*':ab,ti,kw OR 'underdeveloped population*':ab,ti,kw OR 'underdeveloped econom*':ab,ti,kw OR 'low income countr*':ab,ti,kw OR 'middle income countr*':ab,ti,kw OR 'low income nation*':ab,ti,kw OR 'middle income nation*':ab,ti,kw OR 'low income population*':ab,ti,kw OR 'middle income population*':ab,ti,kw OR 'low income econom*':ab,ti,kw OR 'middle income econom*':ab,ti,kw OR 'lower income countr*':ab,ti,kw OR 'lower income nation*':ab,ti,kw OR 'lower income population*':ab,ti,kw OR 'lower income econom*':ab,ti,kw OR 'resource limited':ab,ti,kw OR 'low resource countr*':ab,ti,kw OR 'lower resource countr*':ab,ti,kw OR 'low resource nation*':ab,ti,kw OR 'low resource population*':ab,ti,kw OR 'low resource econom*':ab,ti,kw OR 'underserved countr*':ab,ti,kw OR 'underserved nation*':ab,ti,kw OR 'underserved population*':ab,ti,kw OR 'underserved econom*':ab,ti,kw OR 'under-served countr*':ab,ti,kw OR 'under-served nation*':ab,ti,kw OR 'under-served population*':ab,ti,kw OR 'underserved econom*':ab,ti,kw OR 'deprived countr*':ab,ti,kw OR 'deprived nation*':ab,ti,kw OR 'deprived population*':ab,ti,kw OR 'deprived econom*':ab,ti,kw OR 'poor countr*':ab,ti,kw OR 'poor nation*':ab,ti,kw OR 'poor population*':ab,ti,kw OR 'poor econom*':ab,ti,kw OR 'poorer countr*':ab,ti,kw OR 'poorer nation*':ab,ti,kw OR 'poorer population*':ab,ti,kw OR 'poorer econom*':ab,ti,kw OR lmic:ab,ti,kw OR lmics:ab,ti,kw OR lami:ab,ti,kw OR 'transitional countr*':ab,ti,kw OR 'transitional nation*':ab,ti,kw OR 'transitional econom*':ab,ti,kw OR 'transition countr*':ab,ti,kw OR 'transition nation*':ab,ti,kw OR 'transition econom*':ab,ti,kw OR 'low resource setting*':ab,ti,kw OR 'lower resource setting*':ab,ti,kw OR 'middle resource setting*':ab,ti,kw OR 'Third World*':ab,ti,kw OR 'south east asia*':ab,ti,kw,de OR 'middle east*':ab,ti,kw,de OR Afghan*:ab,ti,kw,de OR Angola*:ab,ti,kw,de OR Angolese*:ab,ti,kw,de OR Angolian*:ab,ti,kw,de OR Armenia*:ab,ti,kw,de OR Bangladesh*:ab,ti,kw,de OR Benin*:ab,ti,kw,de OR Bhutan*:ab,ti,kw,de OR Birma*:ab,ti,kw,de OR Burma*:ab,ti,kw,de OR Birmese*:ab,ti,kw,de OR Burmese*:ab,ti,kw,de OR Boliv*:ab,ti,kw,de OR Botswan*:ab,ti,kw,de OR 'Burkina Faso*':ab,ti,kw,de OR Burundi*:ab,ti,kw,de OR 'Cabo Verde*':ab,ti,kw,de OR Cambod*:ab,ti,kw,de OR Cameroon*:ab,ti,kw,de OR 'Cape Verd*':ab,ti,kw,de OR 'Central Africa*':ab,ti,kw,de OR Chad:ab,ti,kw,de OR Comoro*:ab,ti,kw,de OR Congo*:ab,ti,kw,de OR 'Cote d Ivoire*':ab,ti,kw,de OR Djibouti*:ab,ti,kw,de OR 'East Africa*':ab,ti,kw,de OR 'Eastern Africa*':ab,ti,kw,de OR Egypt*:ab,ti,kw,de OR 'El Salvador*':ab,ti,kw,de OR 'Equatorial Guinea*':ab,ti,kw,de OR Eritre*:ab,ti,kw,de OR Ethiopia*:ab,ti,kw,de OR Gabon*:ab,ti,kw,de OR Gambia*:ab,ti,kw,de OR Gaza*:ab,ti,kw,de OR 'Georgia (republic)'/exp OR Ghan*:ab,ti,kw,de OR Guatemal*:ab,ti,kw,de OR Guinea:ab,ti,kw,de OR Haiti*:ab,ti,kw,de OR Hondur*:ab,ti,kw,de OR India*:ab,ti,kw,de OR Indones*:ab,ti,kw,de OR 'Ivory Coast*':ab,ti,kw,de OR Kenya*:ab,ti,kw,de OR Kiribati*:ab,ti,kw,de OR Kosovo*:ab,ti,kw,de OR Kyrgyz*:ab,ti,kw,de OR 'Lao PDR*':ab,ti,kw,de OR Laos*:ab,ti,kw,de OR Lesotho*:ab,ti,kw,de OR Liberia*:ab,ti,kw,de OR Madagascar*:ab,ti,kw,de OR Malaw*:ab,ti,kw,de OR Mali:ab,ti,kw,de OR Mauritan*:ab,ti,kw,de OR Mauriti*:ab,ti,kw,de OR Micronesi*:ab,ti,kw,de OR Mocambiqu*:ab,ti,kw,de OR Moldov*:ab,ti,kw,de OR Mongolia*:ab,ti,kw,de OR Morocc*:ab,ti,kw,de OR Mozambiqu*:ab,ti,kw,de OR Myanmar*:ab,ti,kw,de OR Namibia*:ab,ti,kw,de OR Nepal*:ab,ti,kw,de OR Nicaragua*:ab,ti,kw,de OR Niger*:ab,ti,kw,de OR 'North Korea*':ab,ti,kw,de OR 'Northern Korea*':ab,ti,kw,de OR (Democratic:ab,ti,kw,de AND People*:ab,ti,kw,de AND 'Republic of Korea':ab,ti,kw,de) OR Pakistan*:ab,ti,kw,de OR 'Papua New Guinea*':ab,ti,kw,de OR Philippine*:ab,ti,kw,de OR Principe:ab,ti,kw,de OR Rhodesia*:ab,ti,kw,de OR Rwanda*:ab,ti,kw,de OR Samoa*:ab,ti,kw,de OR 'Sao Tome*':ab,ti,kw,de OR Senegal*:ab,ti,kw,de OR 'Sierra Leone*':ab,ti,kw,de OR 'Solomon Islands*':ab,ti,kw,de OR Somalia*:ab,ti,kw,de OR 'South Africa*':ab,ti,kw,de OR 'South Sudan*':ab,ti,kw,de OR 'Southern Africa*':ab,ti,kw,de OR 'Sri Lanka*':ab,ti,kw,de OR 'Sub Saharan Africa*':ab,ti,kw,de OR 'Subsaharan Africa*':ab,ti,kw,de OR Sudan*:ab,ti,kw,de OR Swaziland*:ab,ti,kw,de OR Syria*:ab,ti,kw,de OR Tajikist*:ab,ti,kw,de OR Tanzan*:ab,ti,kw,de OR Timor*:ab,ti,kw,de OR Togo*:ab,ti,kw,de OR Tonga*:ab,ti,kw,de OR Tunis*:ab,ti,kw,de OR Ugand*:ab,ti,kw,de OR Ukrain*:ab,ti,kw,de OR Uzbekistan*:ab,ti,kw,de OR Vanuatu*:ab,ti,kw,de OR Vietnam*:ab,ti,kw,de OR 'West Africa*':ab,ti,kw,de OR 'West Bank*':ab,ti,kw,de OR 'Western Africa*':ab,ti,kw,de OR Yemen*:ab,ti,kw,de OR Zaire*:ab,ti,kw,de OR Zambia*:ab,ti,kw,de OR Zimbabw*:ab,ti,kw,de	1,129,403

algorithm to guide the final evaluation into one of the three categories. Questions within the paradigms differ slightly between the assessment for individual randomized trials and cluster randomized trials. Finally, an overall rating of the study was made based on the aforementioned ratings of the five paradigms.

Data Analysis

Data analysis was performed with the software Comprehensive Meta-Analysis (CMA) version 3 (25). Data was compiled from Intention to treat samples (ITT) of the studies when available. Completer samples were used when ITT samples were not reported. Standardized mean differences (Hedges' g) were calculated as a measure of effect size. Hedges' g is calculated by first subtracting the posttest mean of the treatment group from the posttest mean of the control group and then dividing by the pooled standard deviations of both groups. In this study, this measure was utilized to indicate the difference between the treatment and control condition at post-test. In some studies, mean and standard deviations were not reported but mean

TABLE 4 | Search string EBSCO/PsycINFO session results (14 Dec 2018).

Search	Query	Items found
S7	S1 AND S2 AND S5 AND S6	233
S6	DE “Clinical Trials” OR DE “Random Sampling” OR TI (“clinical trial*” OR “controlled trial*” OR random* OR “psycho-social intervention*” OR “psychosocial intervention*” OR “psychological intervention*” OR “psychologic intervention*”) OR AB (“clinical trial*” OR “controlled trial*” OR random* OR “psycho-social intervention*” OR “psychosocial intervention*” OR “psychological intervention*” OR “psychologic intervention*”) OR KW (“clinical trial*” OR “controlled trial*” OR random* OR “psycho-social intervention*” OR “psychosocial intervention*” OR “psychological intervention*” OR “psychologic intervention*”)	214,808
S5	S3 OR S4	1,082,321
S4	**Limiters** - Age Groups: Preschool Age (2-5 yrs), School Age (6-12 yrs), Adolescence (13-17 yrs)	616,658
S3	TI (child* OR adolescen* OR pediatric* OR paediatric* OR pube* OR juvenil* OR youngster* OR kid OR kids OR prepube* OR preadolescen* OR young people* OR minors OR youth* OR teen OR teens OR teenager*) OR AB (child* OR adolescen* OR pediatric* OR paediatric* OR pube* OR juvenil* OR youngster* OR kid OR kids OR prepube* OR preadolescen* OR young people* OR minors OR youth* OR teen OR teens OR teenager*) OR KW (child* OR adolescen* OR pediatric* OR paediatric* OR pube* OR juvenil* OR youngster* OR kid OR kids OR prepube* OR preadolescen* OR young people* OR minors OR youth* OR teen OR teens OR teenager*)	890,439
S2	DE “Anxiety Disorders” OR DE “Generalized Anxiety Disorder” OR DE “Panic Disorder” OR DE “Phobias” OR DE “Acrophobia” OR DE “Agoraphobia” OR DE “Claustrophobia” OR DE “Ophidiophobia” OR DE “School Phobia” OR DE “Social Phobia” OR DE “Post-Traumatic Stress” OR DE “Posttraumatic Stress Disorder” OR DE “Complex PTSD” OR DE “DESNOS” OR DE “Separation Anxiety” OR DE “Separation Anxiety Disorder” OR DE “Major Depression” OR DE “Anaclitic Depression” OR DE “Dysthymic Disorder” OR DE “Endogenous Depression” OR DE “Late Life Depression” OR DE “Postpartum Depression” OR DE “Reactive Depression” OR DE “Recurrent Depression” OR DE “Treatment Resistant Depression” OR DE “Atypical Depression” OR DE “Depression (Emotion)” OR DE “Panic” OR DE “Elective Mutism” OR TI (anxiety OR panic OR phobic OR phobia OR stressor OR “post-traumatic” OR posttraumatic OR “traumatic stress” OR “psychological trauma*” OR depress* OR dysthymi* OR dysthimi* OR dysphori* OR “selective mutism*” OR “elective mutism*”) OR AB (anxiety OR panic OR phobic OR phobia OR stressor OR “post-traumatic” OR posttraumatic OR “traumatic stress” OR “psychological trauma*” OR depress* OR dysthymi* OR dysthimi* OR dysphori* OR “selective mutism*” OR “elective mutism*”) OR KW (anxiety OR panic OR phobic OR phobia OR stressor OR “post-traumatic” OR posttraumatic OR “traumatic stress” OR “psychological trauma*” OR depress* OR dysthymi* OR dysthimi* OR dysphori* OR “selective mutism*” OR “elective mutism*”)	468,777
S1	DE “Developing Countries” OR TI (“developing countr*” OR “developing nation*” OR “developing population*” OR “developing econom*” OR “undeveloped countr*” OR “undeveloped nation*” OR “undeveloped economy” OR “undeveloped economies” OR “least developed countr*” OR “least developed nation*” OR “least developed economy” OR “least developed economies” OR “less-developed countr*” OR “less-developed nation*” OR “less-developed population” OR “less-developed populations” OR “less-developed econom*” OR “lesser developed countr*” OR “lesser developed nation*” OR “lesser developed population” OR “lesser developed populations” OR “lesser developed economy” OR “lesser developed economies” OR “under-developed countr*” OR “under-developed nation*” OR ““underdeveloped countr*” OR “underdeveloped nation*” OR “underdeveloped population*” OR “underdeveloped econom*” OR “low income countr*” OR “middle income countr*” OR “low income nation*” OR “middle income nation*” OR “low income population*” OR “middle income population*” OR “low income econom*” OR “middle income econom*” OR “lower income countr*” OR “lower income nation*” OR “lower income population*” OR “lower income economy” OR “lower income economies” OR “resource limited” OR “low resource countr*” OR “lower resource countr*” OR “low resource nation*” OR “low resource population*” OR “low resource economy” OR “low resource economies” OR “underserved countr*” OR “underserved nation*” OR “underserved population*” OR “underserved economy” OR “underserved economies” OR “under-served country” OR “under-served countries” OR “under-served nation” OR “under-served nations” OR “under-served population” OR “under-served populations” OR “underserved economy” OR “underserved economies” OR “deprived country” OR “deprived countries” OR “deprived nation” OR “deprived nations” OR “deprived population” OR “deprived populations” OR “deprived economy” OR “deprived economies” OR “poor countr*” OR “poor nation*” OR “poor population*” OR “poor econom*” OR “poorer countr*” OR “poorer nation*” OR “poorer population*” OR “poorer econom*” OR lmic OR lmics OR lami OR “transitional countr*” OR “transitional nation” OR “transitional nations” OR “transitional econom*” OR “transition countr*” OR “transition nation*” OR “transition econom*” OR “low resource setting*” OR “lower resource setting*” OR “middle resource setting*” OR “Third World*” OR “south east asia*” OR “middle east*” OR Afghan* OR Angola* OR Angolese* OR Angolian* OR Armenia* OR Bangladesh* OR Benin* OR Bhutan* OR Birma* OR Burma* OR Birmese* OR Burmese* OR Boliv* OR Botswan* OR “Burkina Faso*” OR Burundi* OR “Cabo Verde*” OR Cambod* OR Cameroon* OR “Cape Verd*” OR “Central Africa*” OR Chad OR Comoro* OR Congo* OR “Cote d’Ivoire*” OR Djibouti* OR “East Africa*” OR “Eastern Africa*” OR Egypt* OR “El Salvador*” OR “Equatorial Guinea*” OR Eritre* OR Ethiopia* OR Gabon* OR Gambia* OR Gaza* OR (Georgia AND Republic) OR Ghan* OR Guatemal* OR Guinea OR Haiti* OR Hondur* OR India* OR Indones* OR “Ivory Coast*” OR Kenya* OR Kiribati* OR Kosovo* OR Kyrgyz* OR “Lao PDR*” OR Laos* OR Lesotho* OR Liberia* OR Madagascar* OR Malaw* OR Mali OR Mauritan* OR Mauriti* OR Micronesi* OR Mocambiqu* OR Moldov* OR Mongolia* OR Morocc* OR Mozambiqu* OR Myanmar* OR Namibia* OR Nepal* OR Nicaragua* OR Niger* OR “North Korea*” OR “Northern Korea*” OR (Democratic AND People* AND Republic of Korea) OR Pakistan* OR “Papua New Guinea*” OR Philippine* OR Principe OR Rhodesia* OR Rwanda* OR Samoa* OR “Sao Tome*” OR Senegal* OR “Sierra Leone*” OR “Solomon Islands*” OR Somalia* OR “South Africa*” OR “South Sudan*” OR “Southern Africa*” OR “Sri Lanka*” OR “Sub Saharan Africa*” OR “Subsaharan Africa*” OR Sudan* OR Swaziland* OR Syria* OR Tajikist* OR Tanzan* OR Timor* OR Togo* OR Tonga* OR Tunis* OR Ugand* OR Ukrain* OR Uzbekistan* OR Vanuatu* OR Vietnam* OR “West Africa*” OR “West Bank*” OR “Western Africa*” OR Yemen* OR Zaire* OR Zambia* OR Zimbabw*) OR AB (“developing countr*” OR “developing nation*” OR “developing population*” OR “developing econom*” OR “undeveloped countr*” OR “undeveloped nation*” OR “undeveloped economy” OR “undeveloped economies” OR “least developed countr*” OR “least developed nation*” OR “least developed economy” OR “least developed economies” OR “less-developed countr*” OR “less-developed nation*” OR “less-developed population” OR “less-developed populations” OR “less-developed econom*” OR “lesser developed countr*” OR “lesser developed nation*” OR “lesser developed population” OR “lesser developed populations” OR “lesser developed economy” OR “lesser developed economies” OR “under-developed countr*” OR “under-developed nation*” OR ““underdeveloped countr*” OR “underdeveloped nation*” OR “underdeveloped population*” OR “underdeveloped econom*” OR “low income countr*” OR “middle income countr*” OR “low income nation*” OR “middle income	68,307

(Continued)

TABLE 4 | Continued

Search	Query	Items found
	nation*" OR "low income population*" OR "middle income population*" OR "low income econom*" OR "middle income econom*" OR "lower income countr*" OR "lower income nation*" OR "lower income population*" OR "lower income economy" OR "lower income economies" OR "resource limited" OR "low resource countr*" OR "lower resource countr*" OR "low resource nation*" OR "low resource population*" OR "low resource economy" OR "low resource economies" OR "underserved countr*" OR "underserved nation*" OR "underserved population*" OR "underserved economy" OR "underserved economies" OR "under-served country" OR "under-served countries" OR "under-served nation" OR "under-served nations" OR "under-served population" OR "under-served populations" OR "underserved economy" OR "underserved economies" OR "deprived country" OR "deprived countries" OR "deprived nation" OR "deprived nations" OR "deprived population" OR "deprived populations" OR "deprived economy" OR "deprived economies" OR "poor countr*" OR "poor nation*" OR "poor population*" OR "poor econom*" OR "poorer countr*" OR "poorer nation*" OR "poorer population*" OR "poorer econom*" OR lmic OR lmics OR lami OR "transitional countr*" OR "transitional nation" OR "transitional nations" OR "transitional econom*" OR "transition countr*" OR "transition nation*" OR "transition econom*" OR "low resource setting*" OR "lower resource setting*" OR "middle resource setting*" OR "Third World*" OR "south east asia*" OR "middle east*" OR Afghan* OR Angola* OR Angolese* OR Angolian* OR Armenia* OR Bangladesh* OR Benin* OR Bhutan* OR Birma* OR Burma* OR Birmese* OR Burmese* OR Boliv* OR Botswan* OR "Burkina Faso*" OR Burundi* OR "Cabo Verde*" OR Cambod* OR Cameroon* OR "Cape Verd*" OR "Central Africa*" OR Chad OR Comoro* OR Congo* OR "Cote d'Ivoire*" OR Djibouti* OR "East Africa*" OR "Eastern Africa*" OR Egypt* OR "El Salvador*" OR "Equatorial Guinea*" OR Eritre* OR Ethiopia* OR Gabon* OR Gambia* OR Gaza* OR (Georgia AND Republic) OR Ghan* OR Guatemal* OR Guinea OR Haiti* OR Hondur* OR India* OR Indones* OR "Ivory Coast*" OR Kenya* OR Kiribati* OR Kosovo* OR Kyrgyz* OR "Lao PDR*" OR Laos* OR Lesotho* OR Liberia* OR Madagascar* OR Malaw* OR Mali OR Mauritan* OR Mauriti* OR Micronesi* OR Mocambiqu* OR Moldov* OR Mongolia* OR Morocc* OR Mozambiqu* OR Myanmar* OR Namibia* OR Nepal* OR Nicaragua* OR Niger* OR "North Korea*" OR "Northern Korea*" OR (Democratic AND People* AND Republic of Korea) OR Pakistan* OR "Papua New Guinea*" OR Philippine* OR Principe OR Rhodesia* OR Rwanda* OR Samoa* OR "Sao Tome*" OR Senegal* OR "Sierra Leone*" OR "Solomon Islands*" OR Somalia* OR "South Africa*" OR "South Sudan*" OR "Southern Africa*" OR "Sri Lanka*" OR "Sub Saharan Africa*" OR "Subsaharan Africa*" OR Sudan* OR Swaziland* OR Syria* OR Tajikist* OR Tanzan* OR Timor* OR Togo* OR Tonga* OR Tunis* OR Ugand* OR Ukrain* OR Uzbekistan* OR Vanuatu* OR Vietnam* OR "West Africa*" OR "West Bank*" OR "Western Africa*" OR Yemen* OR Zaire* OR Zambia* OR Zimbabw*) OR KW ("developing countr*" OR "developing nation*" OR "developing population*" OR "developing econom*" OR "undeveloped countr*" OR "undeveloped nation*" OR "undeveloped economy" OR "undeveloped economies" OR "least developed countr*" OR "least developed nation*" OR "least developed economy" OR "least developed economies" OR "less-developed countr*" OR "less-developed nation*" OR "less-developed population" OR "less-developed populations" OR "less-developed econom*" OR "lesser developed countr*" OR "lesser developed nation*" OR "lesser developed population" OR "lesser developed populations" OR "lesser developed economy" OR "lesser developed economies" OR "under-developed countr*" OR "under-developed nation*" OR ""underdeveloped countr*" OR "underdeveloped nation*" OR "underdeveloped population*" OR "underdeveloped econom*" OR "low income countr*" OR "middle income countr*" OR "low income nation*" OR "middle income nation*" OR "low income population*" OR "middle income population*" OR "low income econom*" OR "middle income econom*" OR "lower income countr*" OR "lower income nation*" OR "lower income population*" OR "lower income economy" OR "lower income economies" OR "resource limited" OR "low resource countr*" OR "lower resource countr*" OR "low resource nation*" OR "low resource population*" OR "low resource economy" OR "low resource economies" OR "underserved countr*" OR "underserved nation*" OR "underserved population*" OR "underserved economy" OR "underserved economies" OR "under-served country" OR "under-served countries" OR "under-served nation" OR "under-served nations" OR "under-served population" OR "under-served populations" OR "underserved economy" OR "underserved economies" OR "deprived country" OR "deprived countries" OR "deprived nation" OR "deprived nations" OR "deprived population" OR "deprived populations" OR "deprived economy" OR "deprived economies" OR "poor countr*" OR "poor nation*" OR "poor population*" OR "poor econom*" OR "poorer countr*" OR "poorer nation*" OR "poorer population*" OR "poorer econom*" OR lmic OR lmics OR lami OR "transitional countr*" OR "transitional nation" OR "transitional nations" OR "transitional econom*" OR "transition countr*" OR "transition nation*" OR "transition econom*" OR "low resource setting*" OR "lower resource setting*" OR "middle resource setting*" OR "Third World*" OR "south east asia*" OR "middle east*" OR Afghan* OR Angola* OR Angolese* OR Angolian* OR Armenia* OR Bangladesh* OR Benin* OR Bhutan* OR Birma* OR Burma* OR Birmese* OR Burmese* OR Boliv* OR Botswan* OR "Burkina Faso*" OR Burundi* OR "Cabo Verde*" OR Cambod* OR Cameroon* OR "Cape Verd*" OR "Central Africa*" OR Chad OR Comoro* OR Congo* OR "Cote d'Ivoire*" OR Djibouti* OR "East Africa*" OR "Eastern Africa*" OR Egypt* OR "El Salvador*" OR "Equatorial Guinea*" OR Eritre* OR Ethiopia* OR Gabon* OR Gambia* OR Gaza* OR (Georgia AND Republic) OR Ghan* OR Guatemal* OR Guinea OR Haiti* OR Hondur* OR India* OR Indones* OR "Ivory Coast*" OR Kenya* OR Kiribati* OR Kosovo* OR Kyrgyz* OR "Lao PDR*" OR Laos* OR Lesotho* OR Liberia* OR Madagascar* OR Malaw* OR Mali OR Mauritan* OR Mauriti* OR Micronesi* OR Mocambiqu* OR Moldov* OR Mongolia* OR Morocc* OR Mozambiqu* OR Myanmar* OR Namibia* OR Nepal* OR Nicaragua* OR Niger* OR "North Korea*" OR "Northern Korea*" OR (Democratic AND People* AND Republic of Korea) OR Pakistan* OR "Papua New Guinea*" OR Philippine* OR Principe OR Rhodesia* OR Rwanda* OR Samoa* OR "Sao Tome*" OR Senegal* OR "Sierra Leone*" OR "Solomon Islands*" OR Somalia* OR "South Africa*" OR "South Sudan*" OR "Southern Africa*" OR "Sri Lanka*" OR "Sub Saharan Africa*" OR "Subsaharan Africa*" OR Sudan* OR Swaziland* OR Syria* OR Tajikist* OR Tanzan* OR Timor* OR Togo* OR Tonga* OR Tunis* OR Ugand* OR Ukrain* OR Uzbekistan* OR Vanuatu* OR Vietnam* OR "West Africa*" OR "West Bank*" OR "Western Africa*" OR Yemen* OR Zaire* OR Zambia* OR Zimbabw*)	

change scores were provided. In these cases, Hedges' g was calculated with the mean change scores and standard deviation differences of each group. If more than one measure of anxiety, depression or symptoms of PTSD was reported, these were all included in the analysis. A random effects model was used due to expected heterogeneity among studies. Heterogeneity was measured with the I^2 statistics. We calculated 95% confidence intervals (CI) around I^2 (26), using the non-central Chi squared-based approach within the heterogeneity module for Stata (27). To analyze whether characteristics of the studies predicted effect sizes, we performed subgroup analysis. Subgroup analysis was performed using the mixed effects model (28), in which effect sizes within subgroups are pooled according to the random effects model and the difference between subgroups according to a fixed effects model. Subgroup analyses were performed between cluster and individual randomized controlled trials, studies with different risk of bias assessment and between studies with a waitlist control condition and a non-waitlist control condition. Sensitivity analysis was computed in which potential outliers were excluded. Outliers were defined as studies of which the 95% CI of the effect size did not overlap with the 95% CI of the pooled effect size. Finally, publication bias was examined with Duval and Tweedie's trim and fill procedure and the Egger's test of asymmetry (29).

RESULTS

Selection and Inclusion of Studies

After identifying 2,249 articles in bibliographic databases, records were de-duplicated and 1,505 titles and abstracts were screened for inclusion. Thereafter, the full-text was retrieved from 126 articles and 1,379 articles were excluded. From the 126 reviewed full-texts, 13 studies were included in the meta-analysis. Reasons for excluding articles to a large extent were due to the lack of a screening assessment or criteria within the studies to ensure that individuals with symptoms of either anxiety, depression or PTSD were recruited. Other reasons to exclude articles were study design, outcome, second report on data included, research not conducted in a LMIC, no psychological treatment or publication type [See PRISMA flow diagram (21), **Figure 1**]. Seven studies were excluded based on publication type, as the way in which the study was published, e.g. as an abstract, did not provide sufficient data for the meta-analysis.

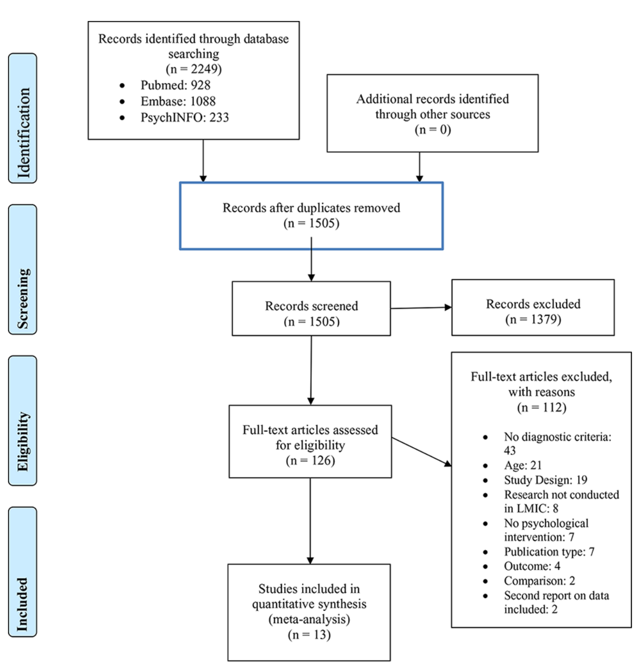


FIGURE 1 | PRISMA flow diagram.

Characteristics of the Included Studies

A total of 13 studies were included in the analysis. In all studies combined, 1,227 participants were enrolled in a psychological intervention and 1,398 participants were enrolled in a control group. One study only recruited girls. Twelve of the studies included in this review were conducted in Asia and Africa, with one study conducted in Southeastern Europe (Kosovo). Out of the studies included, seven were randomized controlled studies, and six were cluster-randomized controlled studies. The number of participants randomized in each study ranged from 15 to 221. The participants included in the studies were aged between 5 and 18 years. Outcomes for depression were reported in ten studies, anxiety in four studies and PTSD in nine studies. Solely one study reported multiple outcomes, for the outcome that was investigated (30). In that study depression was measured with three different outcomes which were all included in this meta-analysis. Psychological treatment was compared to a wait-list control condition in eight studies, four studies compared treatment to a control group and one study utilized treatment as usual (TAU) as a control group which referred to community services available in Zambia (31). The number of treatment sessions ranged from 1 to 16. One study implemented an intervention within an individual format, namely trauma focused CBT (TF-CBT), while the other studies utilized interventions within a group format. These interventions included: 1) Teaching recovery techniques (TRT), which is based on CBT with a focus on symptoms of PTSD wherein individuals are taught coping skills and relaxation techniques with the aim of gradually desensitizing individuals' phobic avoidance behavior (32), 2) Interpersonal therapy (IPT), 3) Creative play for reducing symptoms of depression, which is facilitated through the expression of thoughts and feelings by art, music, roleplays, games, and discussions (33), 4) Mind body skills group, which also incorporates verbal and nonverbal self-expression activities with the goal to provide individuals with a coping tool to deal with experienced trauma (34), 5) Didactic therapy for the management of stress with coping and appraisal strategies, cognitive behavioral techniques and didactic presentations with work sheets on regulation of emotion and behavior (35), 6) Bibliotherapy, with the aim of reducing depressive symptoms by generating insight into ways of thinking and behaving and replacing maladaptive behavior through reading in a therapeutic setting (30), 7) Spiritual hypnosis, which included reinterpretation the meaning of the traumatic event and expressing emotions (36), 8) (37) CBT, Crisis intervention that encourages the discussion and sharing of traumatic experiences and was facilitated by the use of drawing, games, role-play and talking (38), and 9) School-based interventions which included components of CBT including exposure and creative expressive elements such as drawing and games (39–42). Characteristics of the included studies are also depicted in **Table 5**.

Risk of Bias

The risk of bias was assessed separately for individual and cluster randomized controlled trials. Within the individual randomized

TABLE 5 | Characteristics of included studies.

Study	Comparison	Age	Outcomes	Format	N Sessions	Country
32	Teaching recovery techniques vs WL	11–18	Depression PTSD	Group	5	Palestine
37	CBT vs WL	14–17	Depression	Group	5	Southwest Nigeria
33	IPT and creative play vs control	14–17	Depression	Group	16	Northern Uganda
34	Mind body skills group vs WL	14–18	PTSD	Group	12	Kosovo
35	Didactic therapy vs control	12–18	Depression Anxiety Stress	Group	6	Pakistan
30	Bibliotherapy vs control	13–16	Depression	Group	8	Philippines
39	School-based intervention vs WL	11–14	Anxiety Depression PTSD	Group	15	Nepal
36	Spiritual hypnosis assisted therapy vs control	6–12	Avoidance Hyperarousal Reexperiencing	Group	1	Bali
31	TF-CBT vs TAU	5–18	PTSD	Individual	NR	Zambia
38	Crisis intervention vs control	9–15	Depression PTSD	Group	7	Gaza Strip
40	School-based intervention vs WL	7–15	Anxiety Depression PTSD	Group	15	Indonesia
41	School-based intervention vs WL	9–12	Anxiety Depression PTSD	Group	15	Sri Lanka
42	School-based intervention vs WL	8–17	Depression PTSD	Group	15	Burundi

trials, two studies were rated with an overall high risk of bias. This rating was provided due to: the lack of providing clear description of the plan of analysis, the lack of indicating how many participants completed the interventions, and potential deviations from intended interventions due to awareness of treatment condition and due to a lack of information provided on the analysis used to estimate the effect of assignment to intervention. Other studies were most likely not devoid of the awareness of treatment conditions, however, combined with the aforementioned issues these studies received an overall rating of "high risk." The major shortcomings within the randomization process and outcome measurement was that not enough information was provided to apprehend how studies randomized. In respect to the outcome measures, the major shortcoming was that assessors were not blinded. Furthermore, two studies received an overall risk of bias rating of "some concerns" due to: randomization process, deviations from intended interventions, measurement of the outcome measure and no comprehensive reporting of analysis plan and actual analysis. Three studies received an overall rating that was considered as signaling "low risk" of bias. Within the risk of bias for cluster randomized trials, four studies received an overall risk of bias rating considered as potentially incorporating "some risk." This rating was given due to: considerations within the randomization process, no clarity whether outcome data was missing, measurement of the outcome data and potential selection of results. For graphic representation see **Figure 2** for cluster randomized- and **Figure 3** for individual randomized trials.

Effect of Psychological and Psychosocial Interventions

This effect of psychological interventions for all outcomes was (g = 0.62; *95% CI*: 0.27–0.98) with very high heterogeneity (I^2 = 94.41; *95% CI*: 80–91). After excluding outliers, the effect size increased to g = 0.72 (*95% CI*: 0.37–1.07), with very high heterogeneity (I^2 = 86.12; *95% CI*: 87–94). Five studies were defined as outliers and were excluded (See **Figure 4**).

For depression symptoms, psychological interventions yielded a medium effect size (g = 0.43; *95% CI*: 0.06–0.80) with high heterogeneity (I^2 = 94.06; *95% CI*: 85–93). Three outliers were detected and excluded, which led to a decrease in the effect size (g = 0.21; *95% CI*: −0.05–0.48) with a heterogeneity of I^2 = 80.11 (*95% CI*: 88–95).

For anxiety symptoms, psychological interventions showed a small effect for psychological treatments (g = 0.18; *95% CI*: 0.06–0.29) with high heterogeneity (I^2 = 96.46; *95% CI*: 95–98). The effect of psychological treatments for anxiety dropped to g = 0.06 (*95% CI*: −0.06–0.17) with low heterogeneity after excluding one outlier (I^2 = 0.0; *95% CI*: 0–73).

The outcomes for psychological therapies on PTSD symptoms indicated a medium effect size (g = 0.43; *95% CI*: 0.10–0.77) with heterogeneity (I^2 = 92.86; *95% CI*: 86–94). After excluding three studies, which were defined as outliers, the effect size increased to g = 0.50 (*95% CI*: 0.17–0.83) with high heterogeneity (I^2 = 85.54; *95% CI*: 91–96) (see **Table 6** and **7**).

Examination of the funnel plot indicated significant publication bias. Duvall and Tweedie's trim and fill procedure suggested that four studies be imputed as a result of publication bias, which resulted in a decreased effect size of g = 0.16 (95% CI: −0.23 ~ 0.56). Furthermore, Egger's test was significant with an intercept of 7.36 (95% CI: 2.49 ~ 1.87, p = 0.01).

Subgroup Analysis

Effect sizes were significantly smaller when waitlist control group was used, (six studies) compared to studies using another control condition (seven studies; p = 0.05). Subgroup analysis also showed that individually randomized studies (seven studies) had significantly higher effect sizes than cRCTs (six studies; p < 0.005). Lastly, studies with high risk of bias (two studies), some risk of bias (six studies) and low risk of bias (five studies) were compared. These results indicated that quality of study was not significantly associated with effect size (p = 0.43).

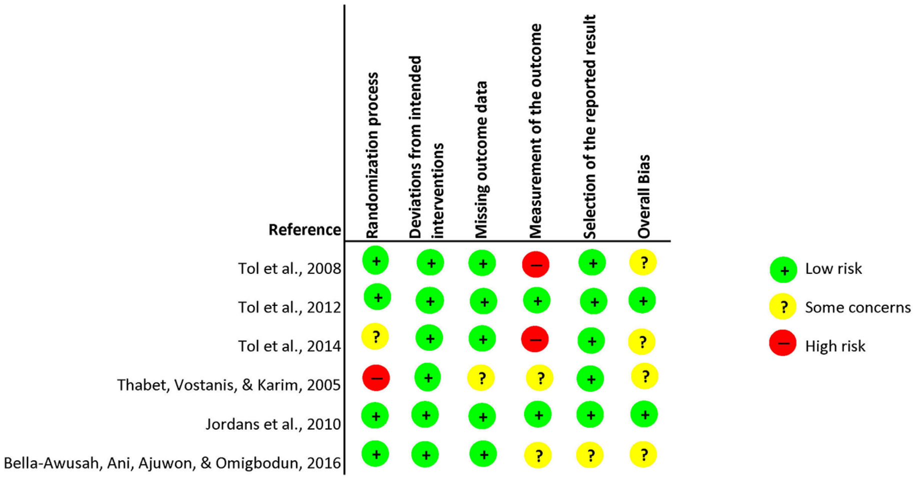
DISCUSSION

This meta-analysis reviewed the effect of psychological interventions on symptoms of depression, anxiety, and PTSD in children and adolescents in low- and middle-income countries. Thirteen studies with a total of 2,626 participants fulfilled the predefined inclusion criteria and were included in

Reference	Randomization process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall Bias
Zafar & Khalily, 2015	?	?	+	+	?	?
Murray et al., 2015	+	+	+	+	+	+
Lesmana, Suryani, Jensen, & Tiliopoulos, 2009	?	–	+	–	+	–
Jacob & De Guzman, 2016	+	–	–	?	?	–
Bolton et al., 2007	+	+	+	+	+	+
Barron, Abdallah, & Heltne, 2016	+	+	+	+	+	+
Gordon, Staples, Blyta, Bytyqi, & Wilson, 2008	+	+	+	?	+	?

+ Low risk
? Some concerns
– High risk

FIGURE 2 | Risk of Bias Cluster Randomized Controlled Trials.



Reference	Randomization process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall Bias
Tol et al., 2008	+	+	+	–	+	?
Tol et al., 2012	+	+	+	+	+	+
Tol et al., 2014	?	+	+	–	+	?
Thabet, Vostanis, & Karim, 2005	–	+	?	?	+	?
Jordans et al., 2010	+	+	+	+	+	+
Bella-Awusah, Ani, Ajuwon, & Omigbodun, 2016	+	+	+	?	?	?

+ Low risk
? Some concerns
– High risk

FIGURE 3 | Risk of Bias Cluster Randomized Controlled Trials.

the analysis. Notably, interventions within the included studies varied greatly from each other. They targeted different symptoms (e.g., anxiety, depression or PTSD) and utilized different treatment approaches with variations in session frequency. Most of the interventions were low-threshold interventions such as school-based interventions. However, some were also more specialized mental health interventions, such as TF-CBT and IPT. Due to very high heterogeneity the results of our meta-analysis should be interpreted with caution.

The result for all pooled outcomes showed a medium to large effect for psychological interventions compared to control conditions. Also, for the outcomes separately a beneficial effect of intervention could be observed. Interventions had a positive effect on the reduction of symptoms of depression (with moderate effect size). Previously, mixed results have been found for the effect of interventions on depression. While Morina etal. (15) report a small to medium effect, Purgato etal. (11) did not find any effect. Further, in the present review a beneficial intervention effect was also found for the treatment of PTSD symptoms. Several other studies have reported a beneficial effect of psychological interventions on symptoms of PTSD (11, 15, 43). Moreover, the included interventions had a positive effect on the treatment of anxiety. However, the observed effect was small. In line with our findings, previous studies in low- and

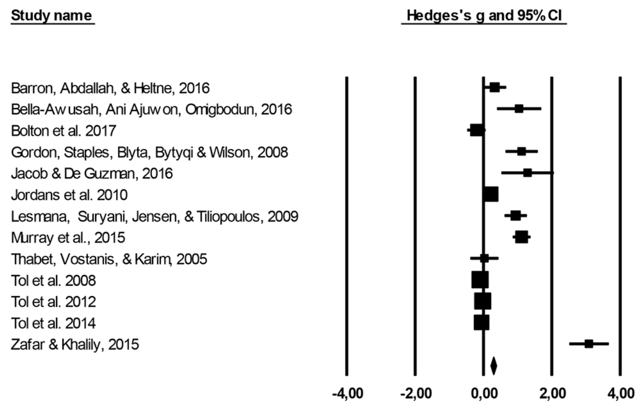


FIGURE 4 | Forest plot of combined outcomes.

TABLE 6 | Combined outcomes of psychological and psychosocial interventions compared to control conditions.

Study	Hedges'g	CI lower limit	CI upper limit	p-value	N
32	0.33	–0.01	0.66	0.06	139
37	1.04	0.39	1.69	0.00	40
33	–0.21	–0.48	0.06	0.13	209
34	1.12	0.64	1.59	0.00	78
30	1.29	0.52	2.06	0.00	30
52	0.21	0.00	0.43	0.05	325
36	0.94	0.61	1.27	2.03	226
31	1.12	0.86	1.38	0.00	257
38	0.03	–0.38	0.44	0.89	89
40	–0.10	–0.29	0.10	0.34	403
41	–0.02	–0.22	0.18	0.85	390
42	–0.05	–0.27	0.16	0.63	329
35	3.09	2.51	3.67	0.00	100

TABLE 7 | Summary of the results.

Analysis	N of studies	Hedges'g	CI	I^2	I^2 CI
Combined outcomes	13	0.62	0.27–0.98	94.41	80–91
Combined outcomes *Outliers excluded*	8	0.72	0.37–1.07	86.12	87–94
Depression	10	0.43	0.06–0.80	94.06	*85–93*
Depression *Outliers excluded*	7	0.21	–0.05–0.48	80.11	88–95
Anxiety	4	0.18	0.06–0.29	96.46	95–98
Anxiety *Outliers excluded*	3	0.06	–0.06–0.17	0.0	0–73
PTSD	9	0.43	0.10–0.77	92.86	86–94
PTSD *Outliers excluded*	6	0.50	0.17–0.83	85.54	91–96

middle-income countries have found some- to no beneficial effect for symptoms of anxiety (11, 43). It is not surprising that the effect for anxiety found in this review was small considering the low number of studies examining anxiety. In addition, the interventions included in this review rarely specifically targeted symptoms of anxiety with evidence-based treatment approaches for anxiety such as exposure (44). The only studies which, to our knowledge, aimed to target anxiety with elements of exposure techniques were school-based interventions, however, it remains unclear how exposure was conducted in these group-based interventions. For all outcomes combined and for symptoms of PTSD, the effect size increased after removing outliers. For symptoms of anxiety and depression, the positive effect of treatment decreased when controlling for outliers.

To investigate the association of specific characteristics of the studies with treatment effectiveness, three subgroup analyses were performed in this review. Within the subgroup analyses that were performed, studies utilizing an individual randomization process were compared to studies utilizing cluster randomization. Results show that individual randomized controlled trials showed a higher effect size compared to cluster randomized trials. An explanation may be higher statistical power to detect differences within individual randomized controlled trials. Furthermore, a significant difference in effect size was found between waitlist control condition and non-waitlist control condition, such as treatment-as-usual or no waitlist. Interestingly, interventions of studies implementing non-waitlist condition were found to be more effective than studies utilizing a waitlist condition. This result is not in line with previous studies (10, 45–47) that showed that the effect of psychotherapy is frequently overestimated when treatments are compared to a waitlist control group. Potentially this result may be explained due to the fact that individuals within the waitlist condition were expecting to receive support and therefore experienced a slight relief in symptoms whereas the non-waitlist condition did not experience this and therefore, more pronounced differences between treatment group and control group could be observed. The number of studies included in the subgroup analysis was small, again, also here conclusion must be taken with caution.

Unfortunately, due to the lack of studies with interventions provided in an individual format, no subgroup analysis could be conducted to analyze whether individual therapy is more effective than group therapy. Interestingly, only one study examined an individually delivered intervention, whereas all other studies evaluated interventions for children and adolescents delivered in group format. Given the lack of health care professionals and the high number of individuals in need of treatment, the group format often is considered as a cost-effective and non-invasive solution. Yet, group interventions may also have disadvantages. For example, stigma and shame may become major barriers hindering individuals from sharing private thoughts and experiences related to symptoms of psychological distress. In addition, it may be more challenging to perform evidence-based strategies such as imaginal or *in vivo* exposure in group sessions than in individual sessions (48).

Limitations

A number of limitations must be noted. Only a total number of thirteen studies was included. Not all of these studies assessed all three outcomes. Hence, when looking at anxiety, depression and symptoms of PTSD separately, the number of studies was even smaller and potentially underpowered. This was also particularly was the case for subgroup analysis. Furthermore, heterogeneity was very high for all outcomes. Studies differed in regard to their methods. Different screening measures were used and time of post-assessments varied. Interventions between studies were very different regarding their session frequency, intensity and content. Therefore, high heterogeneity unfortunately may be inevitable and some issues in aggregating and comparing the data of these different studies must be noted. Moreover, one study (35) included in the analysis reported effect sizes that were exceptionally high, which may suggest that results were overestimated. However, this study was excluded within the sensitivity analysis. Additionally, indications for publication bias were observed, which potentially indicates that the true effect size of psychological treatment may be lower than observed. Lastly, the subgroup analysis on quality of studies did not indicate an association between risk of bias and outcome. Yet, more than half of the studies included were classified as either containing some concerns in regard to risk of bias or containing high risk of bias. As also this subgroup analysis was underpowered, the quality may have still had an effect on outcome. These considerations should be taken into account in light of the results found in this review.

Clinical Implications

The lack of studies implementing and evaluating psychological and psychosocial interventions for children and adolescents in low- and middle-income countries is striking. Considering, that approximately more than half of the world population lives in low-income and lower-middle-income countries (49) and children and adolescents comprise almost half of the populations in these countries, the number of studies we found on children and adolescents is shockingly low. Evidently, more focus needs to be set upon this population, forging more studies to implement effective interventions in this group. Recommendations for interventions include the cultural adaption of an intervention to its target group before it is implemented (50). In most of the studies included in this review, it was unclear if and how the interventions were culturally adapted. To increase effectiveness and acceptability of interventions, cultural adaption should be carried out. Next to cultural adaption, attention should also be given to caregivers when providing children and adolescents with mental healthcare. To our understanding, in none of the interventions were caregivers included. Yet, studies have shown that caregivers play an important role in increasing or reducing the risk of mental illness in children and adolescents (19, 51). Promising interventions that could be implemented have already been constructed, examples of such interventions are KIDNET and EASE (52–54). Narrative exposure therapy (NET) has been evaluated in several high quality trials and has been shown to be effective in treating PTSD in adults (55). KIDNET is a narrative exposure therapy for children, which also has been shown to be effective in reducing symptoms of PTSD and increasing levels of functioning (54). EASE was developed for young adolescents and is the adapted version of the World Health Organization (WHO) developed intervention Problem Management Plus (PM+; WHO, 2016). PM+ is a psychological intervention to reduce psychological distress in populations affected by adversities and is delivered by non-professional helpers (56).

Conclusion

This review suggests that psychological and psychosocial interventions may be effective in reducing symptoms of depression, anxiety, and PTSD for children and adolescents. Results must, however, be considered preliminary since the evidence is not yet strong enough to draw definite conclusions. Due to the large heterogeneity between studies, particularly in regard to the methodological approaches, the combined results of the selected studies must be viewed with caution.

The amount of heterogeneity detected in this meta-analysis certainly limits the conclusions that can be taken from this review. The issues which have contributed to the amount of heterogeneity are the considerably small number of RCTs found that could be included and the variability between the studies found. To allow for a more effective meta-analyses in this field, it is of primary necessity that these issues be addressed. It would be beneficial if research designs and measures are unified across treatment studies (57). Furthermore, researchers should perform complete and transparent reporting on methodological characteristics, and avoid bias that may distort the results (58).

Finally, considering the high prevalence of these common mental health disorders in low- and middle-income countries and the issue of scarce specialized treatment for mental health in these countries, it is essential that psychological treatments be continuously implemented for children and adolescents. Efforts should be made to investigate whether psychological interventions with individual therapy are more effective than group therapies among children and adolescents with high quality trials. Also, when an intervention is to be implemented, considerations should be made as to whether cultural adaption is required first and whether caretakers can and should be included in the intervention.

AUTHOR CONTRIBUTIONS

JU led the conduction of the meta-analysis. CA-S was the second rater for full-text ratings, extracted data as a second rater and assessed risk of bias as a second rater. PC advised and supervised the conduction of the meta-analysis. RV was in charge of creating the search string and performing the search in bibliographic databases. MS advised and supervised the conduction of the meta-analysis. All authors were actively involved in writing the article.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

PERSPECTIVE
published: 20 February 2020
doi: 10.3389/fpsyt.2020.00044

Integrating Urban Adolescent Mental Health Into Urban Sustainability Collective Action: An Application of Shiffman & Smith's Framework for Global Health Prioritization

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OPEN ACCESS

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Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Psychiatry

Received: 10 June 2019
Accepted: 17 January 2020
Published: 20 February 2020

Citation:
Murphy LE, Jack HE, Concepcion TL and Collins PY (2020) Integrating Urban Adolescent Mental Health Into Urban Sustainability Collective Action: An Application of Shiffman & Smith's Framework for Global Health Prioritization. Front. Psychiatry 11:44. doi: 10.3389/fpsyt.2020.00044

The majority (55%) of the world's population lives in urban environments. Of relevance to global mental health, the rapid growth in urban populations around the world and the attendant risks coincide with the presence of the largest population of adolescents the global community has seen to date. Recent reviews on the effects of the urban environment on mental health report a greater risk of depression, anxiety, and some psychotic disorders among urban dwellers. Increased risk for mental disorders is associated with concentrated poverty, low social capital, social segregation, and other social and environmental adversities that occur more frequently in cities. To address these problems, urban adolescent mental health requires attention from decision makers as well as advocates who seek to establish sustainable cities. We examine opportunities to increase the prominence of urban adolescent mental health on the global health and development agenda using Shiffman and Smith's framework for policy priorities, and we explore approaches to increasing its relevance for urban health and development policy communities. We conclude with suggestions for expanding the community of actors who guide the field and bridging the fields of mental health and urban development to meet urban adolescent mental health needs.

Keywords: adolescents, urban health, mental health, sustainable cities, global development, social determinants, sustainable development goals, health policy

INTRODUCTION

The United Nations (UN) New Urban Agenda (NUA) was adopted in Quito, Ecuador in 2016 at the UN Conference on Housing and Sustainable Development (Habitat III) (1). The Agenda's writers envisioned a future for cities in which all city dwellers "without discrimination of any kind are able to inhabit and produce just, safe, healthy, accessible, affordable, resilient and sustainable cities and human settlements to foster prosperity and quality of life for all (1)." The document embraces the 2030 Agenda for Sustainable Development and other relevant frameworks for development, climate change, and poverty reduction (2), and it is timely. As of 2018, 55% of the global population lived in cities, and 1 in 8 urban residents lived in a city with more than 10 million people (3). Cities offer greater opportunities for wealth, employment, social freedoms, and education but inequality is increasingly one of the hallmarks of large cities in high-, middle-, and low-income countries (4). Rapidly urbanizing cities in lower income countries struggle with insufficient urban services, from water and sanitation to healthcare and housing, but the sufficiency of these services can vary considerably within cities at any income level (4). When infrastructural resources are scarce, cities accumulate additional vulnerabilities, e.g., to climate change, to natural disasters, and the effects are most devastating for the poorest residents. In these conditions, poor mental health is one of many negative outcomes, but one of the most disabling for young people.

An estimated 13%–15% of adolescents (10–19 year olds) in low- and middle-income countries (LMIC) live with a mental disorder (5), and depression and anxiety are among the 10 leading causes of disability for children and adolescents globally (6). In the current context of global urbanization, history's largest population of adolescents is transitioning into adulthood (7, 8). Around 1.2 billion adolescents between the ages of 10 and 19 constitute 16% of the world's population (8). The majority of these young people live in Asia, and though less numerous in total numbers, adolescents make up 23% of the Africa region's population (8). These two continents account for 90% of expected urban growth of the coming decades (3). Adolescents who live in cities are exposed to the risks and benefits of urban life during this dynamic and sensitive period of social and neurodevelopment and to the consequent mental health outcomes.

Generally, urbanicity increases risk for psychosis (9–11), anxiety disorders (12), and depression (12). Social isolation, neighborhood poverty, and discrimination also contribute to poor mental health (13). Despite the morbidity associated with mental disorders, neither treatment nor mental health promotion for adolescents has achieved global public health priority. Financing to address these services is distressingly low. From 2007 to 2015, around $190 million of Development Assistance in Child and Adolescent mental health was invested, which amounts to about 0.01% of development assistance for health (14). Fifteen years ago, Sclar et al. (2005) pointed to the growing population of urban adolescents and the dearth of research regarding their health needs (15). As the global community seeks to achieve targets for sustainable development that could address these needs, the time is right for articulating how diverse constituencies can meet shared goals, such as for adolescent mental health and urban sustainability (16, 17).

Urban sustainability, as defined by urban planners and envisioned by the NUA, should enable cities to better meet the mental health needs of young people. It's goal is to "promote and facilitate the long-term well-being of people and the planet through efficient use and management of resources while improving a city's livability, through social amenities, economic opportunity and health, and enabling the city to integrate well with local, regional and global ecosystems (18)." The guiding principles of the New Urban Agenda support this goal **(Box 1)**. The World Health Organization (WHO) argues that healthy citizens are the most important asset of any city, and that "a health lens" should inform the NUA (19). We propose that full implementation of the NUA could, if properly directed, create environments that yield improved mental health for urban adolescents globally, primarily by reducing upstream or "distal" risk factors for mental disorders (16). Consequently, as decision-makers achieve their agreed upon priorities (e.g., meeting targets for the SDGs and NUA) they could also facilitate urban adolescent mental health and wellbeing.

The implementation of a comprehensive agenda requires prioritization and negotiation around which aspects will be fully implemented and resourced. Raising the profile of activities relevant to adolescent mental health may require specific strategies. In this *Perspective*, we apply Shiffman and Smith's criteria for the determinants of political priority to urban adolescent mental health in the global context, in order to identify opportunities for expanding cross-sector engagement to support and prioritize adolescent mental health (20). Briefly, Shiffman and Smith assert that global health initiatives are more likely to receive political priority when four foundational factors support each other: (1) coherent internal framing of *ideas* as well as external framing of the ideas that resonate with leaders; (2) *issue characteristics* that are amenable to credible indicators, objective measurement of severity, and effective interventions; (3) favorable *political contexts* that allow actors to influence decision makers or governance structures that enable collective action; and (4) strong and unified *actor power* (20).

BOX 1 | Principles of the New Urban Agenda (1).

1. Leave no one behind, by ending poverty in all its forms and dimensions, including the eradication of extreme poverty, by ensuring equal rights and opportunities, socioeconomic and cultural diversity, and integration in the urban space, by enhancing liveability, education, food security and nutrition, health and well-being, including by ending the epidemics of AIDS, tuberculosis and malaria, by promoting safety and eliminating discrimination and all forms of violence, by ensuring public participation—providing safe and equal access for all, and by providing equal access for all to physical and social infrastructure and basic services, as well as adequate and affordable housing;
2. Ensure sustainable and inclusive urban economies by leveraging the agglomeration benefits of well-planned urbanization, including high productivity, competitiveness and innovation, by promoting full and productive employment and decent work for all, by ensuring the creation of decent jobs and equal access for all to economic and productive resources and opportunities and by preventing land speculation, promoting secure land tenure and managing urban shrinking, where appropriate;
3. Ensure environmental sustainability by promoting clean energy and sustainable use of land and resources in urban development, by protecting ecosystems and biodiversity, including adopting healthy lifestyles in harmony with nature, by promoting sustainable consumption and production patterns, by building urban resilience, by reducing disaster risks and by mitigating and adapting to climate change.

Exploring Factors for Collective Action

Ideas: Summarizing the Internal Frame

Shiffman and Smith (2007) identify the framing of ideas about an issue as a key component of successful collective action, noting that "any issue can be framed in several ways….Some frames resonate more than others, and different frames appeal to different audiences (20)." Coherent internal framing among key actors in a given field enables the clear communication of priorities of the field to external stakeholders and facilitates unified mobilization of the field. A long history of research on adolescent development and mental health brought together in recent impactful publications demonstrates a coherent internal framing with validity for high-, middle-, and low-income settings (7, 21). Key elements of this consistent internal framing are that (1) adolescence is a dynamic period of neurodevelopment during which young people acquire higher-level cognitive, emotional, and social skills for functioning and expanded interactions beyond the home (7, 22, 23); (2) adolescence provides a meaningful opportunity to remediate insults from early life while setting healthy trajectories for adult life, and, consequently, for the next generation (21); and (3) central to adolescents' health and wellbeing are their interactions with the physical environment, the social context, and the people in these environments (23).

Ideas: Options for External Framing

The "external frame," is the way an issue is portrayed to policymakers and the public (20). We present four ways of framing adolescent mental health that intersect with the principles of the New Urban Agenda: a social justice frame, an economic frame, an urban design and intersectoral governance frame, and a security frame.

Adolescents are dying from preventable causes associated with their mental health, and they have a right to mental health care. Suicide is the second leading killer of older adolescents (24), and the prevalence of self-harm and suicidal behaviors is as high as 15%–31% and 3%–4.7%, respectively, among adolescents in LMICs (25). Self-harm elevates risk of future suicide 30–100 fold (26, 27). The Universal Declaration of Human Rights and the Declaration of the Rights of the Child, which include the rights to health, education, and freedom from neglect, codify adolescents' rights to treatment of mental illness and promotion of mental health (28, 29). Using a human rights lens broadly appeals to the global community (30), which may be important for adolescent mental health advocates, and could serve a unifying purpose as they seek to influence health, education, and urban planning sectors. As Shiffman and Smith show in their case study of the successful elevation of maternal health on the global agenda, a social justice frame added urgency to the issue and spoke to the public, in addition to content experts, which helped build support (30).

"Investments in adolescent health and wellbeing [including mental health] bring a triple dividend of benefits now, into future adult life, and for the next generation of children" (7), and investments in urban neighborhoods are an investment in adolescents. Indirect investments through poverty reduction strategies that increase access to quality education, food security, and mental health services should improve adolescent mental health while also supporting the principles of urban sustainability. Concentrated poverty in urban neighborhoods contributes to poor mental health outcomes (e.g., hopelessness, anxiety, and depression) (31, 32). Direct investments in urban mental health services compound benefits as treatment of mental illness has been shown to improve economic outcomes (33). Highlighting the economic costs of poor mental health or benefits of promoting mental health and averting or treating mental illness may speak to policymakers' needs to seek significant returns on investment and reduce spending over the long-term (34).

Data from South Africa (35), Kenya (36), as well as India, Nigeria, South Africa, and China (37) show that even as urban communities await the implementation of successful poverty reduction strategies or investments in health and education, other factors can support adolescent mental health. Intersectoral urban polices and thoughtful urban design create additional paths to adolescent mental health. Social protection policies that reduce maltreatment and improve parental caregiving quality, and community structures that permit quality peer relationships can support resilience for children with multiple stressors (35). Cultivating friendly home environments, ensuring parental presence in the home, and supporting parental monitoring can reduce behavioral risk even in the most distressed settings, such as informal settlements (36). Community design that enhances neighborhood social support and connection could promote adolescent mental health in some African and Asian contexts (37). Locally accessible economic opportunities that provide resources to adult female carers could be of particular benefit to adolescent girls (37).

A security frame may have less broad appeal, but particular salience for leaders in urban environments racked by youth violence or terrorism. Violence can be both a cause and consequence of poor mental health. Social cohesion, low social control, high neighborhood disorder, and violent victimization or fears of it are associated with adverse adolescent mental health outcomes in high-income countries (11, 31, 32, 38). Growing up in areas with high violence and low social support has been associated with use of negative psychological coping mechanisms, such as acting out or aggressive behavior (39, 40). In communities affected by violence and poverty, considerable international resources are being devoted to the prevention of radicalization (41, 42) and many of these efforts target adolescents (43). A recent report by the UN Development Program used qualitative interviews with people in Africa who were recruited to violent extremist groups to better understand what drew them to those groups (43). Respondents noted that unhappiness in childhood and poor parental support contributed to their participation in extremist groups, and the UNDP called for programming to support healthy parenting, outreach to high risk youth, and initiatives to promote staying in school (43). Anti-radicalization programs may bring unprecedented resources, but come with the ethical complexity of working within defense budgets. Youth mental health advocates should avoid the stigmatizing and dehumanizing framing of adolescents as potential threats to security, but may be valuable voices in efforts to prevent violence and radicalization by strengthening family and educational systems.

Issue Characteristics

The perceived severity of an issue, the availability of credible indicators, and the perceived effectiveness of solutions also determine its political priority (20). Challenges for the perceived severity of child and adolescent mental health problems in LMICs include a small, albeit growing, evidence base, limited awareness of youth mental health issues, and scarce human resources to address these issues (44). In the absence of specialists, clarity of identification and diagnosis create additional challenges to ascertaining illness. However, data do exist to demonstrate the high prevalence of self-injurious and suicidal behaviors among adolescents in LMICs—markers of severity. The Global Burden of Disease studies play a valuable role in providing credible indicators for mental disorders by estimating the prevalence and the disease burden of adolescent mental disorders in HICs and LMICs (6, 45–47). UNICEF's initiative, Measurement of Mental Health among Adolescents at the Population Level (MMAP) seeks to validate instruments in diverse cultural contexts (48). The Lancet Commission on adolescent health and wellbeing now tracks 12 indicators for progress in adolescent health and wellbeing (7, 49). These capture disability adjusted life years for communicable, maternal, and nutritional disorders; injury and violence; and non-communicable diseases, including mental and substance use disorders (7, 49). They also track health risks, such as smoking, binge drinking and obesity as well as social determinants of health (i.e., educational attainment, birth rates, marriage age, the proportion of older adolescents and youth who are not in employment, education or training (NEET) (49). Such indicators can also serve as milestones for achieving urban sustainability. Importantly, feasible, effective interventions for implementation in urban settings can address risks for poor mental health (**Table 1**).

Actor Power

The ideas, evidence and framing of urban adolescent mental health needs can only be meaningful when conveyed and sustained by an influential group of actors and institutions—

TABLE 1 | The New Urban Agenda and elements that support adolescent mental health: mental health sequelae and interventions.

NUA vision for cities	Elements that support adolescent mental health and wellbeing	Mental health sequelae	Relevant Interventions
Cities fulfill their social function, including right to housing and an adequate standard of living, access to drinking water and sanitation, food security and nutrition, health, education, mobility, energy, air quality, livelihoods	Access to adequate housing	Adequate housing associated with improved mental health, (50–54) while lack of housing associated with poor mental health (55–57).	Mental Health Promotion among adolescents in schools using life skills education (58) Supporting Adolescent Orphan Girls to Stay in School (59) Community-based skills-development programs for girls (60)
	Food security and nutrition	Lack of food security and poor nutrition are associated with psychological distress, (61) increased exposure to violence, (62) suicidal behavior, (63) and poor mental health (64–66) including anxiety and depression (67).	
	Education	Quality education supports cognitive development and mental health (52, 68, 69)	
	Health	Timely access to health services enable early identification and management of mental health problems (70–73)	
Cities are participatory, promote civic engagement, engender a sense of belonging and ownership, foster social cohesion, prioritize safe, inclusive quality public spaces	Promote participatory engagement	Adolescence is a time for building agency, and youth civic engagement is positively associated with mental health into adulthood (74–77).	School-based life skills training (78) Social Networking Action for Resilience (79) Family-centered programing (80) Social identity intervention to build and strengthen social group membership (81) Social connectedness in street-involved youth (82)
	Social cohesion and belonging	Social connectedness (peers, school, family) promotes adolescent mental health (80–83).	
	Safe public spaces	Safe public spaces are essential for adolescent development, socialization, and mental health (84).	
Cities achieve gender equality and empower all women and girls and prevent discrimination, violence, and harassment	Reduced exposure to gender-based violence	Adolescents, particularly young women, who experience gender-based violence are at higher risk of poor mental health outcomes (85, 86)	Intimate partner violence prevention (87, 88) Gender-based violence prevention program (89, 90)
	Reduced exposure to gender-based discrimination	Gender-based discrimination has negative effects on youth mental health (91).	
Cities meet the challenges and opportunities of inclusive and sustained economic growth	Reduce youth unemployment	Youth employment has positive effects on both youth mental health (90, 92–94) and economic growth	Economic empowerment intervention (88) Vocational training (95, 96)
Promote age- and gender-responsive planning and investment for sustainable, safe accessible urban mobility	Increased urban mobility for youth	A built environment which enables safe transport and mobility has positive impacts on youth mental health (97–99).	Transport-related factors that could impact public mental health (100)

the policy community (101). For global mental health and adolescent health, this community continues to grow in size and diversity. These actors have helped to create and support a set of rules, norms and strategies within and across organizations that help promote portrayals (or framing) of adolescent health and wellbeing (101, 102). The launch of WHO's Global Accelerated Action for the Health of Adolescents (AA-HA)!, the Global Strategy for Women's Children's and Adolescents' Health, and the Lancet Commission on adolescent health and wellbeing (7), and UNICEF's and other multilateral interests in the intersections of gender, mental health, and adolescence (103), reflect the increasing prominence of adolescent health on the global health agenda and the action of the policy community. Guiding institutions in global mental health (e.g., the World Health Organization, the Lancet Commission on Global Mental Health and Sustainable Development) also highlight adolescent mental health as priority (17).

Importantly, additional actors have joined the policy community. The voices of people with lived experience of mental health conditions are present. Youth advocates have also joined the community (https://globalmentalhealthcommission.org/youth-campaign/). There remain critical missing voices. A majority of the published research we identified on urban adolescent mental health focused on young people in distressed communities in HICs and LMICs. These youth represent a resource for engagement in advocacy for urban mental health. The New Urban Agenda identifies youth engagement and capacity development as explicit goals (1), and there is preliminary evidence that involvement in collective action can promote youth development among adolescents in some contexts (74). Global platforms like citiesRISE, which value intersectoral collaboration along with youth mobilization and leadership for progress in adolescent mental health, could help to bridge these policy communities (104).

In order to bridge relevant communities, the global mental health community and child and adolescent advocates need to learn the language of urban sustainability and generate knowledge relevant to both sectors. Universities, which often support and foster interdisciplinary collaborations, may be ideal settings for engaging young people and bridging urban design, mental health, climate, public health, and other relevant constituencies. New publications and recent textbooks (105) are also establishing this field as a discipline (https://www.urbandesignmentalhealth.com/), which will help to strengthen the evidence generated from new collaborative efforts.

Policy Contexts

Shiffman and Smith argue that one route to political priority in global health is to take advantage of policy windows, i.e., political moments that present opportunities for advocates to influence decision makers (20). The NUA and the SDG's provide such opportunities for advocates of urban adolescent mental health. Many non-health SDGs are associated with distal determinants of poor mental health and achieving certain SDG targets could provide particular benefit for urban adolescents, given the relationships among environment, social experience and mental health outcomes (16). Together, these documents provide a platform for integrating adolescent mental health within urban development.

While international agreements are vital, domestic policy windows provide opportunities for small steps toward integration of adolescent mental health into the broader health and development agenda. Zimbabwe's Ministry of Health and Child Care recently formed a Mental Health Research Task Force to set national research priorities and better coordinate and publicize research (106). While the Task Force includes a diverse set of researchers and practitioners, including some with an interest in child and adolescent mental health, it includes no one who focuses on urban planning or city development. Especially at the outset of the taskforce, there are opportunities to advocate for the inclusion of new perspectives. Finding opportunities to incorporate voices of mental health specialists into urban planning conversations and urban planners into mental health conversations may help advance adolescent urban mental health in local or national policies and priorities.

In addition to policy windows, Shiffman and Smith draw attention to global governance structures (norms and institutions), which can both facilitate and impede collective action. Responsibility for adolescent mental health in an urban environment spans numerous areas of government, including ministries of health, urban planning, and criminal justice institutions. This fragmentation of responsibility can lead to "buck passing", in which every institution believes that the problem is the responsibility of another institution, and thus no institution takes definitive action (30, 107). Advocates face the challenge of uniting these institutions around common commitments and projects to promote adolescent wellbeing. Conversely, the benefit of having multiple institutions involved is that there is potential for pooling of resources toward a common goal (108). While it does not focus on adolescents, one model of successful cross-sectoral collaboration between health and urban planning is the Research Initiative for Cities and Health (RICHE) network, an interdisciplinary group based out of University of Cape Town that has set priorities for and works to promote urban health research in Africa (109, 110).

How and whether decision makers seize policy windows to promote action for mental health is also influenced by the cultural context. In settings where tremendous social stigma is attached to mental disorders and where structural stigma relegates mental health issues to low priority, identifying and vocally advocating for those portions of other agendas (like the NUA or SDG 11) that can enhance mental health outcomes becomes even more important.

Other Considerations

We have outlined how Shiffman and Smith's criteria–the framing of ideas, engaging an enlarged policy community, using evidence to shape the messages, and taking advantage of the current political context, i.e., countries' desires to achieve the SDGs—can contribute to prioritization of actions that simultaneously support adolescent mental health and action for urban sustainability (20). Shiffman notes that these factors lack a theoretical basis, but the importance of ideas and how they are portrayed, as well as the strength of the institutions the policy community forms, become more salient factors of influence through some theoretical lenses (101). Perspectives of mental health advocates in an LMIC setting support the importance of coordinating a shared message among many stakeholders, active engagement with decision makers, and effectively communicating messages (111).

CONCLUSIONS

Chisholm and colleagues showed that investment in mental health in LMICs yields a significant return (112). Investment in adolescent mental health is particularly advantageous. Adolescence is a critical stage of development, and the contexts in which adolescents live help shape their ability to contribute fully to society socially, economically, and intellectually. Importantly, the actions to achieve these ends can be integrated with other efforts. Just as integrating mental health into broader health care efforts is critical for achieving good outcomes for most health conditions, (113, 114), what we know about urban adolescent mental health can inform implementation of the New Urban Agenda. In order for this to occur, relevant decision-makers must recognize the value and importance of actions that support adolescents in urban contexts. Progress toward translating strategies to action that successfully influences decision makers will depend on meaningful alliances across sectors and disciplines, careful understanding of political leaders' concerns in local contexts (101), and the ability to thoughtfully and nimbly respond to these.

AUTHOR CONTRIBUTIONS

PC developed the concept of the manuscript. LM, TC, HJ, and PC reviewed relevant literature, and wrote sections of the manuscript. PC and HJ wrote the final draft. All authors approved the final manuscript.

FUNDING

PC was supported in part by a contract with the Global Development Incubator for research coordination activities with citiesRISE.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

SYSTEMATIC REVIEW
published: 18 March 2020
doi: 10.3389/fpsyt.2020.00150

Child and Adolescent Mental Health Policy in Low- and Middle-Income Countries: Challenges and Lessons for Policy Development and Implementation

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OPEN ACCESS

Edited by:
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Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Psychiatry

Received: *07 May 2019*
Accepted: *17 February 2020*
Published: *18 March 2020*

Citation:
Zhou W, Ouyang F, Nergui O-E, Bangura JB, Acheampong K, Massey IY and Xiao S (2020) Child and Adolescent Mental Health Policy in Low- and Middle-Income Countries: Challenges and Lessons for Policy Development and Implementation. Front. Psychiatry 11:150. doi: 10.3389/fpsyt.2020.00150

Background: Child and adolescent mental health (CAMH) policy is essential for the rational development of mental health systems for children and adolescents. However, there is a universal lack of CAMH policy, especially in low- and middle-income countries (LMICs). Therefore, this review aims to identify challenges and lessons for LMICs to develop and implement CAMH policy.

Methods: PubMed (1781-), MEDLINE (1950-), EMBASE (1966-), and PsycINFO (1895-) were searched from inception to December 31, 2018, for publications on CAMH policy development and/or implementation. Abstracts and main texts of articles were double screened, and extracted data were analyzed through thematic synthesis.

Results: A total of 31 publications were included through the systematic review. Six major challenges were identified for CAMH policy in LMICs: (i) poor public awareness and low political willingness; (ii) stigma against mental disorders; (iii) biased culture values toward children, adolescents and CAMH, from developmental nihilism to medicalization; (iv) the lack of CAMH data and evidence, from service statistics to program evaluation; (v) the shortage of CAMH resources, including human resources, service facilities, and funding; and (vi) unintended consequence of international support, including reducing local responsibilities, planning fragmentation, and unsustainability. Six lessons to overcome challenges were summarized: (i) rethinking the concept of CAMH, (ii) encouraging a stand-alone CAMH policy and budget, (iii) involving stakeholders, (iv) reinforcing the role of research and researchers in policy process, (v) innovating the usage of human and service resources, and (vi) maximizing the positive influence of international organizations and non-governmental organizations.

Conclusion: Many LMICs are still facing various challenges for their CAMH policy development and implementation. To overcome the challenges, great and long-term efforts are needed, which include great determination of from domestic and global agents, multidisciplinary innovations, and collaboration and coordination from different sectors.

Keywords: children and adolescents, mental health policy, low- and middle-income countries, challenges and barriers, policy development and implementation

INTRODUCTION

Children and adolescents constitute 44% of the world's population (1), and 10–20% of them suffer mental health problems (2), which is a leading cause of health-related burden in this age group (3). As the majority of adult mental disorders have their first onset in childhood and adolescence (4), prevention and treatment for children and adolescents are of significant importance.

Child and adolescent mental health (CAMH) policy, as a roadmap, guides the development of CAMH services (5, 6). Fully realizing the importance of CAMH policy, the World Health Organization (WHO) in 1977 recommended that every country throughout the world should have a National Plan for Child Mental Health. In 1992, the International Association for Child and Adolescent Psychiatry and Allied Profession endorsed the WHO's 1977 recommendation (7). In 2005, WHO released *Mental Health Policy and Service Guidance Package: Child and Adolescent Mental Health Policies and Plans* to help nations develop CAMH policy (8).

However, Shatkin and Belfer's (5) survey from 2002 found that no countries in the world had a mental health policy or action plan uniquely pertaining to children and adolescents and that only 18% countries (35 of 191) had mental health policies, which might have some beneficial impact on children and adolescents. The WHO Child Mental Health Atlas published in 2005 also demonstrated the paucity of CAMH policy, as only 30% of the 66 reported countries had national CAMH policy (9, 10). The global absence of CAMH policy remains unchanged. According to WHO Mental Health Atlas 2017, only 46% of 78 responding countries had a plan or strategy for CAMH (11).

Approximately 90% of children and adolescents live in low- and middle-income countries (LMICs), where they form up to 50% of the population (1). However, results from Shatkin and Belfer's survey and WHO Child Atlas Project consistently revealed that the dearth of CAMH policy in LMICs was even more severe (5, 9, 10). Based on the above fact, this article focuses on LMICs according to the latest classification by World Bank (12). Through a systematic review, this study aims to identify (i) challenges for LMICs to develop and implement CAMH policy and (ii) lessons for LMICs to overcome challenges, based on a global-scope experience.

METHODS

Based on the theory of policy life circle (13) and suggestions of *WHO Mental Health Policy and Service Guidance Package* (14), we divided the whole policy process into three stages: policy development, implementation, and outcome. As the policy outcome or the progress of policy is a result of policy development and implementation, it will be more useful to examine the stages of policy development and implementation to find the reasons for unsatisfactory policy outcome. Therefore, we focused on exploring challenges at the first two policy stages of CAMH policy in LMICs.

Search Strategy and Selection Criteria

We conducted a systematic review using the steps recommended in the PRISMA 2009 Checklist. PubMed (1781—), MEDLINE (1950—), EMBASE (1966—), and PsycINFO (1985—) were searched from inception to December 31, 2018, by WZ on January 4, 2019. Searches in the field of title were conducted using the following terms: ("child" or "children" or "adolescent" or "youth" or "young people") AND ("psychiatry" or "psychiatric" or "mental health" or "psychology" or "psychological") AND ("policy" or "policies" or "plan" or "strategy" or "strategies" or "legislation" or "law"). Bibliographies were also hand-searched to identify other relevant publications. Publication language was restricted to English.

We included both original research and reviews on CAMH policy development or implementation. Studies were excluded if they (i) were descriptive introductions on content of CAMH policies and lacked information on policy development or implementation; (ii) were only data analysis to examining the progress of certain CAMH policy goal, without discussion of policy challenges or lessons; (iii) were CAMH-related research, which provided evidence for treatment or implications for future CAMH policies; (iv) introduced a new instrument for CAMH policy development or evaluation, but without empirical information on CAMH policies in LMICs for data extraction; (v) were book reviews or conference abstracts; or (vi) were not available in full text.

Screening, Abstraction, and Synthesis

Identified citations went through title and abstract screening and then full-text screening. The two-stage screening was conducted independently by WZ and FO, and any disagreement was resolved through consensus.

We extracted data from included publications, which included countries/regions being studied, and sentences or paragraphs on LMICs' challenges and global lessons for CAMH policy development and implementation. Extracted data were analyzed with thematic synthesis. The process of synthesis went through the following steps: (i) familiarization with data, (ii) generation

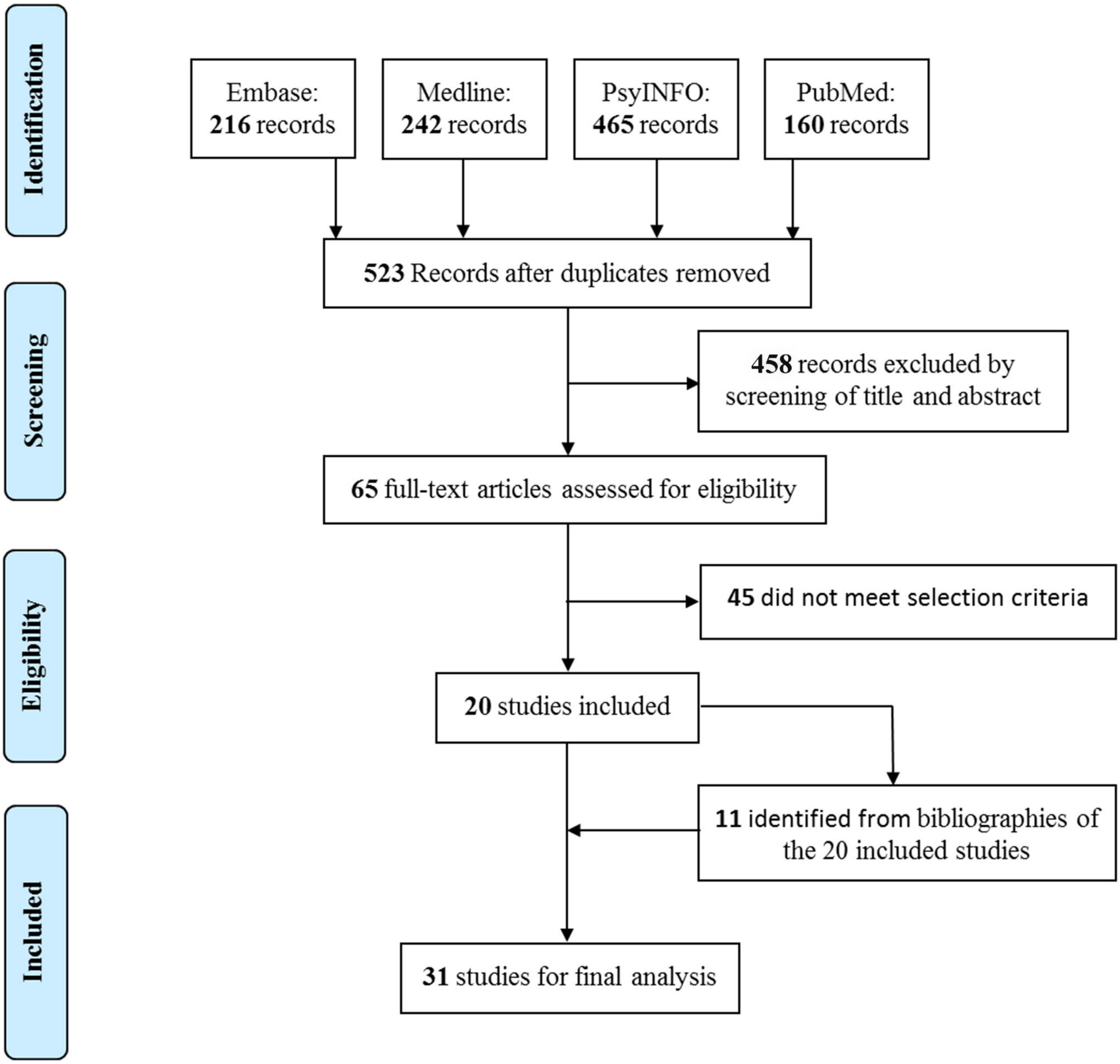

FIGURE 1 | Process and results of study selection.

of initial codes, (iii) searching for themes, (iv) review of themes, and (v) definition and naming of themes (15, 16). The process was iteration, and these steps were not unidirectional.

RESULTS

In this systematic review, 523 records were initially identified from the four databases, and 20 met the selection criteria. Based on the reference lists of the 20 included publications, we further identified 11 eligible studies for the final analysis after assessing full texts (**Figure 1**). Among the 31 included publications (**Appendix 1**), seven focused on specific countries or regions of low-middle-income economy, including Ghana, India, Iraq, South Africa, Uganda, Vietnam, Zambia, Latin America and the Caribbean, and sub-Saharan Africa; two restricted the discussion on developing countries or resource-poor countries; 14 were based on countries or regions of high-income economy, including Canada, Hungary, Lithuania, United Kingdom, United States, and Europe; and the remaining eight elaborated the issue of CAMH policy in general or globally.

Challenges for LMICs' CAMH Policy Development and Implementation

Based on literature on LMICs or regions, we found that LMICs are faced with not only the absence of CAMH policy, but also implementation difficulties, including the lack of feasibility and sustainability of policy (17, 18). Six major challenges for LMICs' CAMH policy emerged as themes from thematic analysis. The detailed list of codes and themes is presented in **Appendix 2**.

Poor Public Awareness and Low Political Willingness

Public awareness and political willingness are key factors determining whether CAMH can enter policy agenda. However, even compared with adult mental health, CAMH is neither understood or interested by the public, nor placed as a priority among policy makers in LMICs (18–20). This is because CAMH is a field with relatively new development of knowledge, and the dissemination of knowledge is slower (5, 9, 17). Therefore, the magnitude of CAMH problem is not recognized by the public or policy makers (20). Moreover, many LMICs are confronted with political turmoil, economic upheavals, and other health challenges including HIV/AIDS, tuberculosis, and high infant and maternal mortality (8, 17, 20–23), which largely distract the public's and politicians' attention from CAMH. The situation is worsened by the facts that CAMH professionals are reluctant to engage in policy debates (5) and that children and adolescents are least capable of advocating for themselves, as they cannot vote, have almost no political or economic influence, and are even often abrogated rights (5, 8, 9).

Stigma Against Mental Disorders

It is well known that stigma widely exists in patients with mental disorders, and children and adolescents are particularly vulnerable to stigma. It can negatively affect children and adolescents and their families obtaining support and seeking for mental health services, as parents are often blamed and even forced to move frequently because of mental health problems of their children (8, 24). Stigma of mental disorders is also reported among health professionals. Some young professionals in LMICs like Vietnam and Sierra Leone are reluctant to take CAMH as their career and service providers are sometimes discriminated for working in CAMH facilities (24, 25). Stigmatizing views are also found in policy makers. For example, in a quoted interview script of a Uganda politician, mental disorder was described as a bad disease with personal hate, and no interest in mental health was also clearly expressed (17). The widespread stigma makes stakeholders reluctant to talk the issue of CAMH in public forums, which turns CAMH, an important issue, into a low-profile topic in policy agenda.

Biased Culture Values Toward Children and Adolescents and CAMH

There are several perceptions toward children and adolescents (including CAMH) embedded in different cultures in LMICs. Relevant perceptions were well summarized by Harper and Çetin (19): (i) children belong to their parents, and society cannot interfere; (ii) children's development is determined by heredity, fate, or immutable social facts such as race, class, or social group, and efforts for change are worthless; (iii) schools suffice for child development, including CAMH, and no other extra attention and arrangement are needed; (iv) CAMH is seen as a luxury, and mental health need among children and adolescents is less important than physical health; (v) CAMH problems are treated as a pure medical issue, without recognizing the role of nonmedical factors; (vi) children and adolescents are regarded as an economic investment, and policy's economic benefits are emphasized over other aspects such as children's rights; (vii) children and adolescents' rights should be recognized. The first six perceptions either hold an evasive, passive attitude or suggest inaction toward CAMH, or adopt a unilateral view for CAMH, which all exert negative influence on CAMH policy development and implementation.

The Lack of CAMH Data and Evidence

Data and evidence are the foundation of policy formulation and evaluation. However, methodologically and culturally appropriate epidemiological studies of the prevalence of CAMH problems are few in most LMICs (2, 4, 5), which makes it difficult to determine the arrangement of CAMH services in both quantity and organizing manner. As for the statistics of current CAMH services in LMICs, the low responding rates of WHO CAMH Atlas survey (66 of 192) (9, 10) and WHO Mental Health Atlas 2017 (78 of 192) (11) indicate the difficulty in obtaining data, which was also encountered in the multicountry survey designed for our study (**Supplementary Material**). Evidence for effective treatment protocols and health interventions is also limited, and evaluation of CAMH policy or programs is not common (6, 8, 17, 23).

The Shortage of CAMH Resources

Mental health resources, including mental health services, human resources, and funding, are insufficient in LMICs (2, 26). Despite the large population of children and adolescents in LMICs, resources for CAMH are scarcer, compared with those for adults. According to WHO Mental Health Atlas 2017, the median number of mental health beds per 100,000 population in low-income and lower middle-income countries is below 7 for adults and below 0.2 for children and adolescents; the median number of psychiatrists per 100,000 population in LMICs is below 2 for adults and below 0.1 for children and adolescents (11). In addition to the quantity of human resources, capacity is also listed as a barrier, which includes capacity of decision makers to develop a feasible CAMH policy, capacity of service providers to implement CAMH program, and capacity of researchers to provide evidence (8, 17, 18). As for funding, most LMICs do not have a specific budget for CAMH, and paying CAMH services out of patients' pocket is very common (7, 27). In addition, sustainability of funding is affected by factors such as election cycles (8).

Unintended Consequence of Support From International Organizations and Non-governmental Organizations

International organizations (IOs) and nongovernmental organizations (NGOs) play an important role in promoting CAMH in LMICs, through providing expertise, funding, and/or services (8, 23, 25, 28). However, support from IOs and NGOs also can have unintended consequences. First, the presence of support from IOs and NGOs may reduce local government's sense of urgency for taking responsibility of CAMH (25). Second, driven by donors' interest, many IOs and NGOs implement programs targeting at specific disorders, such as autism (23). For LMICs relying heavily on external support for CAMH, disorder-specific orientation may lead to local government's biased focus on certain aspects of CAMH and fragmentation of policy planning (6, 23, 28).Third, support from IOs and NGOs tends to be project-oriented with short time term. In some LMICs, where most CAMH services are provided by IOs and NGOs, the cease of projects will disturb children's and adolescents' utilization of mental health services (8, 28).

Overcoming Challenges: Global Experience and Lessons

Six major lessons to overcome challenges emerged as themes from thematic analysis on the global-scope literature. The detailed list of codes and themes is presented in **Appendix 3**.

Rethinking the Concept of CAMH

In LMICs such as Nigeria, CAMH problems are regarded as "a curse by the gods and punishment for evil doing," according to local beliefs (20). Therefore, it is very necessary to rethink local perception of CAMH problems, which is good for reducing stigma and raising public awareness and political willingness. Globally, CAMH has been described in several ways. For example, to promote the public's acceptability and the parity between mental and physical health, CAMH problems are framed as being like any other physical illnesses (29). For another example, policy documents of England describe CAMH as a socioeconomic issue. Child and adolescent mental health problem is viewed as consequence of socioeconomic inequities and difficulties and as socioeconomic burden in the future (30). More recently, positive mental health is proposed, which emphasizes that mental health is not only the absence of mental disorders but also positive child development (8, 31, 32). Scientific evidence and social and cultural context should be considered when thinking CAMH in LMICs.

Encouraging a Stand-Alone CAMH Policy and Budget

Although CAMH can be covered in policies of education, social welfare, and general health, a specific CAMH policy is still needed (33). On one hand, having a specific CAMH policy in place can demonstrate the government's commitment (34). Once government is committed to CAMH, the challenge of lacking resources can also be alleviated through resource mobilization by the government. Under a specific CAMH policy, a stand-alone budget should be assigned accordingly, so as to avoid competition from other health issues and even from adult mental health (32, 35). On the other hand, because CAMH should be considered in a wider social context and because CAMH services are also intersectorial in nature (6, 7), a specific CAMH policy can provide an overall framework to guide intersectorial collaboration.

Involving Stakeholders

Similar to mental health policy in general, full involvement of stakeholders is needed (27, 36). A consensus among stakeholders through negotiation will lay the foundation for CAMH policy's successful implementation (27). Stakeholders include mental health professionals, parents, social services, religious leaders, and educators (19). Moreover, specifically to CAMH policy, children and adolescents should not be regarded only as passive recipient of protection and intervention by adults; instead, they need to be recognized with respect and given a voice during policy formulation (8, 19).

Reinforcing the Role of Research and Researchers in Policy Process

Because of status quo that children and adolescents have weak or even no voice in society, researchers should take the responsibility of advocacy through research and involving policy process (20, 37). First, methodologically sound and culturally compatible research on CAMH prevalence, treatment, and strategy evaluation should be conducted to make the problem of CAMH visible and to provide solutions, which can be adopted in policy and service planning. However, it should be well noted that merely providing data and generating evidence are far from enough (38). Researchers should understand policy process and communicate CAMH evidence to policy makers and the public in a more user-friendly way. For example, syntheses of research evidence, rather than scattered knowledge, are preferred (37, 39, 40). Meanwhile, partnership between researchers and policy makers is suggested, for timely communication of research findings. To further prioritize CAMH into policy agenda, some literature suggests that researchers can point out the relationship between CAMH and other key issues in LMICs (8). In China, scholars linked the case management of patients with psychotic disorders to social stability and then successfully persuaded Chinese government to launch a series of policies and fund National Continuing Management and Intervention Program for Psychosis (41). As poverty is an important issue in many LMICs, advocacy through linking CAMH with local economy such as quality of future labor forces and analyzing economic impact of CAMH problems could be useful attempts (28, 30).

Innovating the Usage of Human and Service Resources

As the shortage of CAMH resources in LMICs is difficult to change in the short term (42), it will be more feasible to make innovative and optimal use of the existing human and service resources (18). First, CAMH training can be provided to pediatricians, primary healthcare providers, and school teachers, so that they can deliver CAMH screening and less complex interventions (18, 23). Second, collaboration with other systems should be encouraged (23). Those systems include health and non-health ones, such as HIV/AIDS project networks, education systems, and faith-based organizations. Collaboration systems can be formal and informal ones, such as traditional healers (8). Third, capacity-building programs for service users should be developed. Some effective programs include parenting skills training for families and life skills training for children and adolescents themselves (18). Those programs can relieve CAMH problems from the perspective of prevention and then reduce pressure on CAMH medical resources, such as pediatric psychiatrists and hospitals.

Maximizing Positive Influence of IOs and NGOs

Despite some unintended consequences of IOs' and NGOs' work, their role in promoting CAMH policy and services is undeniably important in both high-income countries (HICs) and LMICs (23, 43). They can enhance their positive influence in the following ways: first, intergovernment organizations, such as the United Nations (UN) and WHO, can initiate international treaties to promote LMICs' governments' commitment to CAMH (8). From the 30-year-ago *UN Convention of the Rights of the Child* to the recent *Comprehensive Mental Health Action Plan 2013–2020*, CAMH is written into member states' obligations. Second, coordination between local governments, IOs, and NGOs can reduce competitions, overlapping of resource, and fragmented planning of CAMH (28). Third, IOs and NGOs should consider sustainability at the beginning of their CAMH program development and naturally move programs' independence and sustainability (25). In addition, instead of leading CAMH services themselves, IOs and NGOs should make more efforts on supporting local professionals, through providing consultation, capacity building, and funding research (19, 44).

DISCUSSION

Although CAMH policy is an important issue in LMICs, there is very limited research on this topic, as this systematic review found only nine publications on CAMH policy in LMICs or regions of low- to middle-income economy. It indicates that CAMH policy is not only neglected by the public and policy makers, but also receives insufficient attention in the academic circle. Our research results suggest that research is needed not only for raising public awareness, but also for providing local experience and expertise for CAMH policy formulation and implementation and promoting CAMH policy progress in LMICs. Therefore, more research on this topic should be advocated in the future.

Many challenges presented in the results part can be commonly found in HICs' or LMICs' mental health policy in general (42); however, when they come to CAMH policy, they have greater severity. One potential reason is that the mental health needs of children and adolescents are often not considered separately from those of adults, especially under resource-constraint settings. For example, many LMICs do not set mental health professionals or facilities specifically for children and adolescents (7, 18, 22). Because of different developmental competencies and growth trajectories, mental health professionals without special training for CAMH cannot provide mental health services needed by children and adolescents. This makes CAMH resources extremely insufficient. Furthermore, children and adolescents are vulnerable groups with weak voices in political and economic arenas (5, 8, 9). As a result, their needs are more likely to be neglected, compared with adult patients with mental disorders.

Many challenges, such as the lack of CAMH resources, also exist in HICs (30, 32, 43), and HICs have their thinking and proposed solutions, some of which are included in this review. We acknowledge the difference of socioeconomic and cultural context between HICs and LMICs (18) and potential problems of direct transplantation of HICs' experience (45). Therefore, we did not present specific services organizing models, but only selected general lessons, which may be applicable for or can provide inspiration for LMICs. For example, the holistic approach to CAMH was not included, because the literature shows that even HICs such as Lithuania faced many challenges and obstacles in its implementation (31). To better solve challenges for LMICs, more research based on local experience and expertise is in extreme need.

This review was limited to English language publications, which potentially excluded some relevant studies on non–English-speaking countries. In addition, there were few available studies on CAMH policy in LMICs; therefore, there might be some other challenges for CAMH policy in LMICs unreported in existing publications, which were also not captured in our review. In an attempt to cross-check the representativeness of the challenges identified by our systematic review, we also designed an exemplifying multicountry survey to cross-check our results, based on a convenient sampling of PhD students from six LMICs. The survey results were consistent with findings from our systematic review. Survey details were presented as a **Supplementary Material**.

CONCLUSION

There are many challenges for LMICs to develop and implement CAMH policy. Overcoming all the challenges will be a long and difficult process. In the future, promoting CAMH policy in LMICs will need great determination from domestic and global agents, multidisciplinary innovations, and collaboration and coordination from different sectors.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

AUTHOR CONTRIBUTIONS

WZ and SX designed this research, including the systematic review protocol and questionnaire for the multi-country survey. WZ and FO screened for inclusion papers in the systematic review. FO, O-EN, JB, KA, and IM collected data in the multi-country survey. WZ and SX extracted and analyzed data. WZ drafted the manuscript. All authors read and approved the final manuscript.

FUNDING

This work was funded by the National Social Science Foundation of China (17CGL050) to WZ.

ACKNOWLEDGMENTS

We would like to thank Carlye Chaney from the Department of Anthropology, Yale University for her assistance with English Language Editing.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2020.00150/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

ORIGINAL RESEARCH
published: 31 July 2020
doi: 10.3389/fpsyt.2020.00772

Factors Associated With HIV Disclosure and HIV-Related Stigma Among Adolescents Living With HIV in Southwestern Uganda

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Specialty section:
This article was submitted to
Public Mental Health,
a section of the journal
Frontiers in Psychiatry

Received: *15 April 2019*
Accepted: *21 July 2020*
Published: *31 July 2020*

Citation:
Nabunya P, Byansi W, Sensoy Bahar O, McKay M, Ssewamala FM and Damulira C (2020) Factors Associated With HIV Disclosure and HIV-Related Stigma Among Adolescents Living With HIV in Southwestern Uganda. Front. Psychiatry 11:772. doi: 10.3389/fpsyt.2020.00772

HIV-related stigma has been documented as one of the greatest obstacles to reducing HIV spread, engagement in HIV treatment, and poor mental health functioning among people living with HIV (PLWH). Although disclosure is important for people to receive social support, the fear of stigma and discrimination prevents PLWH from disclosing their status. For children and adolescents growing up with HIV –with no opportunity for normal transition through adolescence due to stigma, it is important to identify additional family and community support systems, to improve their acceptance and health outcomes, including mental health functioning. This study examined family communication and social support factors associated with HIV disclosure and HIV-related stigma among children and adolescents living with HIV in Uganda. Baseline data from an NICHD-funded *Suubi +Adherence* study (N=702) were analyzed. Adolescents (10–16 years) were eligible to participate if they were: 1) HIV positive and knew their HIV status, 2) prescribed antiretroviral therapy, 3) lived within a family, not an institution, and 4) enrolled in one of the 39 health centers in the study area. Multiple regression analyses were conducted to determine family communication (frequency and level of comfort communicating with caregiver), social support (perceived child-caregiver support and social support from classmates, close friends, teachers, and caregivers), associated with HIV disclosure, disclosure comfort, and HIV internalized and anticipated stigma. Results show that level of comfort communicating with a caregiver was significantly associated with how often children discussed their HIV status with other people (B = 0.02, 95% CI = 0.00, 0.03, p = 0.04), and level of HIV disclosure comfort (B = 0.08, 95% CI = 0.04, 0.13, p < 0.01). In addition, support from within the school environment, i.e., from teachers and classmates, was uniquely associated with both HIV disclosure and HIV-related stigma. Findings point to schools as potential for implementing HIV stigma-reduction programs. In addition, programming aimed at improving HIV care and treatment outcomes for adolescents living with HIV should consider incorporating both family communication strengthening and

HIV-stigma reduction strategies in their efforts, in order to improve HIV health-related outcomes, including overall mental health functioning of HIV positive adolescents.

Keywords: HIV-stigma, HIV disclosure, HIV-positive adolescents, social support, Uganda

INTRODUCTION

An estimated 1.8 million children below the age of 15 years are living with HIV worldwide (1). Sub-Saharan Africa (SSA) is heavily burdened by HIV, with 85% of new infections among adolescents happening in the region (1). Within SSA, Uganda has an HIV prevalence of 7.5% among 15- to 49-year-olds (2). In addition, Uganda also reports unprecedented numbers of HIV-infected children, with close to 150,000 children (age, 0–14 years) living with HIV (3). While availability and access to free antiretroviral therapy (ART) has decreased child mortality (4), it has increased the likelihood that a large number of children living with HIV (CLWH) will transition into adulthood with HIV as a chronic, highly stigmatized illness (5, 6). Unfortunately, the HIV/AIDS-related stigma they experience results in a lower quality of life (6). Yet, stigma-reduction interventions targeting CLWH in SSA are almost nonexistent (7, 8).

HIV stigma is associated with public blame and moral condemnation for contracting the disease (9–11). Although HIV-related stigma has been declining in SSA since 2000, it remains high in several countries (1). In Uganda –one of the SSA countries that has implemented the stigma index survey, 25% of respondents indicated that they would avoid buying vegetables from a vendor living with HIV, suggesting that many people still lack basic HIV knowledge and showing the level of stigma associated with HIV/AIDS. In addition, people living with HIV (PLWH) report experiencing discrimination in health care settings, including being denied health services because of their HIV status and health care professionals disclosing their HIV status without their consent (1). Indeed, stigma has been documented as one of the greatest obstacles to slowing HIV spread, by perpetuating the culture of silence and fear, and preventing individuals from testing and seeking health care (12).

Stigma can be manifested internally due to perceived negative public attitude and self-blame. These feelings, in turn, predict psychological distress, including depression and post-traumatic stress disorders (13, 14), feelings of loneliness and social isolation (15–17), poor treatment and adherence (14, 18, 19), poor HIV-related physical health (20); and increase the risk of loss to follow up among CLWH (21). In addition, stigma can also be manifested externally through negative stereotypes (sexual promiscuity and deviant sexual behaviors), prejudice (fear, aversion, hatred), and discrimination, all of which create social barriers including access to healthcare (22).

Adolescence is a challenging period, associated with social, emotional, and cognitive changes (23, 24). Hence, children and adolescents need additional support, including emotional support and acceptance from family and community members. Yet, many CLWH cannot count on the "normal" transition to adolescence due to stigma where community and family members ostracize them for being HIV positive (25). Many of these children live with extended family members after losing their parents to HIV, where stigma is further perpetuated through rejection, verbal insults, avoidance, and ostracism due to unfounded fears of infection (26, 27). Because of such environment, CLWH may not develop strong attachment bonds with extended family and fail to develop a positive self-concept (25). This unsupportive social environment increases the risk for mental distress, including depression and trauma (4).

Social Support, Disclosure, and HIV-Related Stigma

The relationship between social support and HIV-related stigma has been documented. Stigma is associated with low social support and deteriorating physical and mental health functioning (28, 29). In turn, low social support is associated with lower engagement levels in HIV treatment, resulting into poor HIV-related health outcomes, including poor mental health functioning (30). In addition, previous studies have demonstrated that the negative impact of stigma extends to the individuals' social connections i.e. stigma limit PLWH's ability to seek and engage in new supportive relationships, especially due to lack of disclosure (31). As such, while disclosure is important for PLWH to access and receive social support, the fear of discrimination prevents them from disclosing their status (32, 33). Indeed, higher levels of internalized stigma have been associated with low levels of disclosure and social interactions (27, 34–36); which in turn affects adherence to antiretroviral therapy (37, 38). Taken together, these findings suggest that social support and disclosure are critical for HIV care and treatment, as well as ensuring positive HIV-related health outcomes, including mental health functioning. However, despite the literature documenting the close relationship between social support, HIV disclosure, and stigma, very few studies have examined social support factors associated with HIV disclosure and stigma, especially among CLWH (39).

Theoretical Framework

Social support serves to protect individuals from potential negative effects of life stressors (40). People who are socially integrated and who experience supportive relationships have better physical and mental health outcomes (41–43). However, while PLWH may have to disclose their HIV status to receive support, they must also perceive that social support exist before they make the decision to disclose. Indeed, PLWH are more likely to weigh the costs and benefits associated with disclosure (44). For example, while disclosure may mean that an individual may no longer have to struggle with concealing a secret, they may be exposed to stigma as a result (32, 33). Indeed, HIV nondisclosure is attributed to expectation of stigma (45). As such, PLWH with greater social support will have greater intention to disclosure their status (40, 46). On the other hand, individuals experiencing or anticipating stigma may be less likely to disclose their HIV status to others.

Guided by social support theory and based on previous studies discussed above, this study examines factors, including family communication and social support from multiple sources (i.e., caregivers, teachers, friends, and classmates) associated with HIV disclosure (keeping HIV a secret from others, and frequency of talking about HIV status) and HIV internalized and anticipated stigma. We expect that family communication and social support factors will be associated with higher levels of HIV disclosure and disclosure comfort, and low levels of HIV stigma. On the other hand, we expect that HIV stigma will be associated with low levels of HIV disclosure and disclosure comfort (**Figure 1**).

METHODOLOGY

Study Sample and Setting

This study utilized data from the *Suubi+Adherence* study (2012–2018), a randomized clinical trial funded by the National Institute for Child Health and Human Development (NICHD, grant R01HD074949). The Suubi+Adherence study examined an innovative family-based economic empowerment intervention on ART adherence among perinatally HIV-infected adolescents in southern Uganda, a region heavily affected by HIV/AIDS. Uganda has a national HIV prevalence rate of 7.5% among adults aged 15 to 49 years, with a higher prevalence rates of 12% in the southern region where the study was implemented (2). A total of 702 adolescents living with HIV (ages 10–16 years at study initiation) were enrolled in the study. Adolescents were eligible to participate if they were: 1) HIV positive and knew their status, 2) prescribed ART, 3) lived within a family, broadly defined and not an institution, and 4) enrolled in one of the 39 health centers or clinics in Rakai, Masaka, Lwengo, Lyantonde, Bukomasimbi, and Kalungu Districts in Uganda, where the study was implemented. Health clinics were randomized to either the treatment arm receiving an economic empowerment intervention or the control arm receiving usual care for adolescents living with HIV in the region. Randomization was conducted at the clinic level to avoid cross-arm contamination. All adolescents meeting the inclusion criteria at a particular clinic were invited to participate in the study and assigned to the same study condition. Adolescents who were not disclosed to and those who were not prescribed ART were excluded. Details on participant recruitment are provided in the study protocol (47).

Participation in the study was voluntary. Written informed consent and assent were obtained from caregivers and adolescents respectively. In November 2012, the study received Institutional Review Board (IRB) approvals from Columbia University (AAAK3852), the Uganda National Council for Science and Technology (UNCST, SS 2969), and Makerere University School of Public Health Higher Degrees, Research, and Ethics Committee (210).

Data Collection

This study utilized baseline data collected *via* a 90-minute interviewer-administered assessment survey by trained Ugandan interviewers. All interviewers completed CITI certificate and Good Clinical Practice training. The interviewers were fluent in both English and Luganda—the local language widely spoken in the study area. All instruments were translated into Luganda by trained individuals fluent in both English and Luganda. Translated versions were then back translated into English to ensure accuracy and were certified by the Makerere University Institute for Languages in Uganda. All measures used in the Suubi+Adherence study were adapted and tested among children affected by HIV (48–52).

Measures

The primary outcomes are: 1) HIV disclosure, 2) Level of comfort disclosing HIV status, and 3) HIV-related stigma.

HIV disclosure was measured using 2 indicators: 1) Do you keep your HIV status a secret from others such as, friends and other family members? (1, Never to 5, Always), with a higher score indicating non-disclosure; and 2) How often do you talk to people about your HIV status? (1, Never to 5, All of the time), with a higher score indicating higher frequency of disclosure.

Level of comfort disclosing HIV status to others was assessed using 4-items asking participants how comfortable they felt

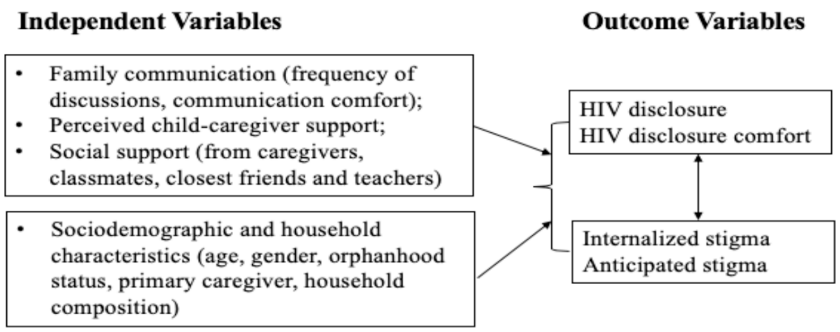

FIGURE 1 | Conceptual Framework.

about letting others know of their HIV status, such as other children in the school, friends, other family members, and girl/boyfriends, on a 4-point scale (1, very uncomfortable; 4, very comfortable). A summary score was created (Cronbach's alpha = 0.72) with a higher score indicating a higher comfort level of HIV status disclosure.

HIV-related stigma was assessed by 9-items adapted from the Berger Stigma Scale (53), measuring both internalized and anticipated stigma. Participants were asked to indicate the extent to which they agreed with the statements that HIV positive people have made about themselves (internalized stigma), and how HIV affects people (anticipated stigma), on a 4-point scale (1, strongly disagree; 4, strongly agree). Sample items include: "I feel guilty about having HIV" and "Having HIV affects whether people like you or not." Items in the inverse direction were reverse coded to create a summary score (Cronbach's = 0.74), with a higher score indicating higher levels of internalized and anticipated stigma.

Social support was measured by support from multiple sources, and perceived child-caregiver support. First, *s*ocial support from multiple sources was assessed using 24 items adapted from the Friendship Qualities Scale (54). The scale assesses the impressions of the quality of children's friendships and relationships with their caregivers, classmates, closest friends and teachers, on a 5-point scale (1, never; 5, always). Summary scores were created, with higher scores indicating higher levels of social support from multiple sources (Cronbach's alpha = 0.76). Each source of support (e.g. parent/guardian, teacher, classmate, friend) was analyzed separately in the analysis. Second, perceived child-caregiver support and family cohesion were both measured using items adapted from the Family Environment Scale (55) and the Family Assessment Measure (56). To measure *perceived child-caregiver support*, participants were asked to rate the adults they live with, on each of the 18-items (Cronbach's alpha = 0.76), on a 5-point scale (1, never; 5, always). Summary scores were generated, with higher scores indicating higher levels of perceived child-caregiver support.

Family communication was measured in two ways: 1) frequency of discussions related to sensitive topics with caregiver, and 2) level of comfort discussing sensitive topics with caregiver. Frequency of discussions was assessed for 11-topics (Cronbach's alpha = 0.74), including HIV/AIDS and other sexually transmitted infections, puberty, education and future plans, and risk-taking behaviors, on a 5-point scale (1, never; 5, always). Participants were then asked to state their level of comfort discussing the above topics (Cronbach's alpha = 0.76) with their caregivers, on a 4-point scale (1, very uncomfortable; 4, very comfortable). Summary scores were created for both measures, with higher scores indicating higher frequency and comfort levels of communication between the child and caregiver.

A number of participants' sociodemographic and household characteristics were included in the model, including age, gender, orphanhood status, primary caregiver, and household composition (number of people in the household and number of children in the household).

Analysis Procedures

All analyses were conducted in SPSS version 25. Bivariate analyses (independent sample t-tests and chi-square tests) were conducted on key sociodemographic and household characteristics, social support factors, family communication, HIV disclosure and HIV-related stigma. These were compared and contrasted by gender. Multiple regression analyses were conducted to determine family communication and social support factors associated with HIV disclosure (keeping HIV a secret from others, and frequency of talking about HIV status), level of disclosure comfort, HIV internalized stigma and anticipated stigma, controlling for participants' sociodemographic and household characteristics. All predictors were selected based on previous literature (i.e. factors associated with disclosure and HIV-related stigma). Statistical significance was set a prior at the 5% level.

RESULTS

Family Communication, Social Support, HIV Disclosure, and HIV Stigma

Sample sociodemographic and household characteristics are summarized in **Table 1**. Participants reported moderate levels of family communication and social support from their classmates, friends, teachers, and caregivers (**Table 2**). We

TABLE 1 | Baseline Characteristics of the Sample (N = 702).

Variable	Total Sample, % (N)	Boys, %(n)	Girls, %(n)	χ^2/*t*-value	*p*-value
Gender	100(702)	43.6(306)	56.4(396)		
Age (Mean, SD) (min/max: 10–16)	12.42(1.98)	12.28(1.90)	12.53(2.03)	–1.92	0.06
Orphanhood status				0.27	0.63
Orphan child	65.0(456)	66.0(202)	64(254)		
Non-orphan	35.0(246)	34.0(104)	36(142)		
Household Characteristics					
Primary caregiver				0.12	0.94
Biological parent	47.1(330)	46.7(143)	47.3(187)		
Grandparents	29.4(206)	29.1(89)	29.6(26.7)		
Other relative (siblings, aunt, uncle, other)	23.5(165)	24.2(74)	23.0(91)		
Number of people in HH (Mean, SD) (min/max: 2–18)	5.74(2.56)	5.72(2.58)	5.77(2.54)	–0.25	0.80
Number of children in HH (Mean, SD) (min/max: 1–14)	2.35(1.92)	2.18(1.81)	2.47(2.0)	–1.98	0.05

TABLE 2 | Family Communication, Social Support, HIV Disclosure and HIV-Related Stigma (N = 702).

Variable	Total Sample, N = 702 (Mean, SD)	Boys (n=306) Mean (SD)	Girls (n=396) Mean (SD)	χ^2/*t*-value	*p*-value
Family Communication					
Frequency of communication with caregiver (min/max: 10–55)	24.81(7.9)	23.63 (7.7)	25.73 (8.1)	−3.49	<0.01
Level of comfort communicating with caregiver (min/max: 10–44)	23.14 (5.9)	22.23 (5.9)	23.84 (5.9)	−3.59	<0.01
Perceived child-caregiver support (min/max: 31–86)	58.98 (9.7)	60.65 (10.2)	61.64 (9.5)	−1.33	0.18
Social Support from Multiple Sources					
Caregiver (min/max: 6–30)	23.26 (5.02)	22.24 (4.94)	24.05 (4.94)	−4.81	<0.01
Teacher (min/max: 10–30)	22.95 (4.66)	22.45 (4.51)	23.34 (4.74)	−2.36	0.02
Friend (min/max: 8–30)	21.16 (4.71)	20.30 (4.62)	21.82 (4.68)	−4.28	<0.01
Classmate (min/max: 8–30)	22.38 (4.64)	21.66 (4.63)	22.95 (4.58)	−3.44	<0.01
HIV Disclosure					
Do you keep your HIV status a secret from others? (min/max: 1–5)	2.96 (1.69)	2.81 (1.65)	3.07 (1.73)	−2.01	0.05
How often do you talk to people about your HIV status? (min/max: 1–5)	1.94 (1.12)	2.05 (1.19)	1.86 (1.06)	2.15	0.03
Level of comfort talking about HIV-status with others (min/max: 3–16)	7.32 (3.12)	7.90 (3.43)	6.87 (2.79)	4.39	<0.01
HIV-Related Stigma					
Internalized (min/max: 6–23)	12.19 (3.79)	12.19 (3.84)	12.18 (3.75)	0.02	0.99
Anticipated (min/max: 3-12)	6.41(2.92)	6.49(3.03)	6.35(2.8)	0.62	0.54

observe statistically significant gender differences. Specifically, compared to boys, girls were more likely to report higher levels of communication frequency with their caregivers on specific topics (25.73 vs. 23.63, p<0.01), higher comfort levels communicating with their caregivers (23.84 vs. 22.23, p<0.01), and higher levels of social support from multiple sources, including from caregiver (24.05 vs. 22.24, p<0.01), teacher (23.34 vs. 22.45, p=0.02), friend (21.82 vs. 20.30, p<0.01) and classmate (22.95 vs. 21.66, p<0.01).

Regarding HIV disclosure, compared to boys, girls were more likely to keep their HIV status a secret from others compared to boys (3.07 vs. 2.81, p=0.05), and less likely to feel comfortable discussing their HIV status with others (6.87, vs.7.90, p<0.01). In terms of HIV-stigma, participants reported moderate levels of both internalized stigma (M=12.19, SD=3.79) and anticipated stigma (M= 6.41, SD =2.92). No statistically significant differences were observed between boys and girls.

Regressions on HIV Disclosure and HIV Stigma

Results from multiple regression analyses assessing factors associated with HIV disclosure are presented in **Table 3**. Family communication and social support factors were not

TABLE 3 | Family Communication and Social Support Factors Associated with HIV Disclosure and Disclosure Comfort (N = 702).

Variable	Do you keep your HIV status a secret from others?			How often do you talk to people about your HIV status?			Level of comfort talking about HIV status with others		
	B **(95% CI)**	***β***	***p*-value**	***B*** **(95% CI)**	***β***	***p*-value**	***B*** **(95% CI)**	***β***	***p*-value**
Female child	0.08 (−0.20, 0.36)	0.02	0.57	−0.25 (−0.43, −0.06)	−0.11	0.01	−1.22 (−1.73, −0.71)	−0.19	<0.01
Age	0.04 (−0.03, 0.12)	0.05	0.26	−0.02 (−0.07, 0.02)	−0.04	0.33	0.07 (−0.20, 0.07)	−0.04	0.32
Orphaned child	−0.14 (−0.46, 0.18)	−0.04	0.39	0.03 (−0.18, 0.24)	0.01	0.78	−0.02 (−0.60, 0.56)	−0.01	0.60
Household Characteristics									
Primary caregiver (biological parent)	0.12 (−0.42, 0.19)	−0.03	0.45	0.08 (−0.28, 0.12)	0.04	0.42	0.19 (−0.74, 0.37)	0.03	0.51
Number of people in HH	−0.07 (−0.16, 0.03)	−0.10	0.17	−0.03 (−0.09, 0.04)	−0.06	0.39	0.05 (−0.12, 0.23)	0.04	0.55
Number of children in HH	0.04 (−0.08, 0.17)	0.05	0.50	−0.01 (−0.09, 0.08)	−0.01	0.92	−0.17 (−0.40, 0.06)	−0.10	0.16
Family Communication									
Frequency of communication	0.15 (−0.01, 0.03)	0.07	0.11	0.01 (−0.00, 0.02)	0.07	0.11	0.03 (−0.01, 0.06)	0.07	0.10
Level of comfort communicating	0.01 (−0.02, 0.03)	0.02	0.66	0.02 (0.00, 0.03)	0.09	0.04	0.08 (0.04, 0.13)	0.16	<0.01
Social Support (ref. caregiver)									
Teacher	0.03 (−0.01, 0.06)	0.07	0.20	−0.03 (−0.06, −0.01)	−0.13	0.02	−0.02 (−0.09, 0.05)	0.04	0.51
Friend	0.02 (−0.01, 0.05)	0.06	0.24	0.01 (−0.02, 0.03)	0.02	0.73	−0.01 (−0.06, 0.06)	−0.01	0.98
Classmate	0.03 (−0.01, 0.07)	0.09	0.08	0.04 (0.02, 0.07)	0.17	<0.01	0.05 (−0.02, 0.12)	0.07	0.17
Perceived child-caregiver support	−0.01 (−0.02, 0.01)	−0.03	0.55	0.00 (−0.01, 0.01)	0.01	0.96	−0.01 (−0.04, 0.04)	−0.01	0.87
HIV-Related Stigma									
Internalized stigma	0.70 (0.03, 0.11)	0.15	<0.01	−0.03 (−0.06, −0.01)	−0.11	0.03	0.11 (−0.19, −0.03)	−0.13	<0.01
Anticipated stigma	−0.06(−0.12, −0.01)	−0.10	0.04	0.07 (0.03, 0.10)	0.17	<0.01	0.14 (0.04, 0.25)	0.05	<0.01
Constant	0.42 (−1.27, 2.11)		0.80	1.49 (0.39, 2.60)		0.01	6.51 (3.43, 9.60)		<0.01
F-value (df)	2.90		<0.01	3.26		<0.01	4.08(14)		<0.01

B = unstandardized coefficient, β = standardized estimate.

associated with HIV disclosure (i.e. keeping HIV a secret from others). Both internalized stigma (*B* = 0.70, 95%CI = 0.03, 0.11, p<0.01) and anticipated stigma (*B* = −0.06; 95% CI = −0.12 to −0.01, p = 0.04) were associated with keeping HIV a secret from others. Level of comfort communicating with caregiver (*B*= 0.02, 95%CI = 0.00, 0.03, p=0.04), social support from a teacher (*B* = −0.03; 95% CI = −0.06 to −0.01, p = 0.02), and social support from a classmate (*B* =0.04, 95%CI = 0.02, 0.07, p<0.01), were all associated with how often children talked to other people about their HIV status. Similarly, internalized stigma (*B* = −0.03, 95% CI = −0.06 to −0.01, p=0.03), anticipating stigma (*B*=0.07, 95% CI= 0.03, 0.10, p<0.01), and being a female child (*B* = −0.25, 95% CI = −0.43 to −0.06, p=0.01) were associated with how often children talked to other people about their HIV status. Level of comfort communicating with a caregiver (*B*= 0.08, 95% CI =0.04, 0.13, p<0.01), internalized stigma (*B* = 0.11, 95% CI = −0.19, −0.03, p<0.01), and anticipated stigma (*B* = 0.14, 95% CI = 0.04, 0.25, p<0.01), were all associated with HIV disclosure comfort.

Regarding HIV stigma (**Table 4**), frequency of communication with caregiver (*B*= 0.05, 95% CI = 0.01, 0.09, p=0.02), social support from a friend (*B* = −0.07, 95% CI = −0.15, −0.01, p=0.05), social support from a classmate (*B* = −0.09, 95% CI = −0.17, −0.01, p=0.03), higher levels of perceived child-caregiver support (*B*= −0.05, 95% CI = −0.09, −0.01, p=0.01), and HIV nondisclosure (*B* = 0.20, 95% CI = 0.03, 0.38, p=0.02), were all associated with internalized stigma. In addition, social support from a classmate (*B*= −0.08, 96% CI = −0.14, −0.01, p =0.02), and having a biological parent as the primary caregiver (*B* = −0.63, 95% CI = −1.14, −0.12, p = 0.02), were associated with lower levels of anticipated stigma. Frequency of HIV status disclosure was also associated with anticipated stigma (*B* = 0.26, 95% CI = 0.05, 0.47, p = 0.02). Disclosure comfort was not associated with HIV stigma.

DISCUSSION

This paper examined family communication and social support factors associated with HIV disclosure and HIV-related stigma among adolescents living with HIV in southwestern Uganda.

Our findings indicate the following. First, girls report higher levels of family communication and social support from multiple sources compared to boys. One explanation could be the socialization of girls versus boys in Uganda. Girls tend to be supported more because they are expected to take care of others in the family, including becoming home makers in the absence of an adult or a parent (57, 58). On the other hand, boys are trained to become responsible for the wellbeing of the household, including becoming breadwinners—from an early age (59). Overall, this finding is consistent with other studies that have documented gender differences in social support and social networks—reporting that women tend to have larger and more varied social networks with more friends and more social support compared to men (60–62).

Second, even with high levels of social support, girls in our study were less likely to discuss their HIV status with others and to feel comfortable disclosing their status, compared to boys. This finding is in line with previous studies in SSA that have documented lower disclosure levels among women—specifically, due to their economic and social vulnerability relative to men, fear of rejection, abandonment or partner violence (63–65).

TABLE 4 | Family Communication and Social Support Factors Associated with HIV Internalized and Anticipated Stigma (N = 702).

Variable	Internalized Stigma			Anticipated Stigma		
	B (95% CI)	*β*	*p-value*	*B* (95% CI)	*β*	*p*-value
Female child	−0.07 (−0.69, 0.54)	−0.01	0.82	−0.02 (−0.45, 0.50)	−0.01	0.92
Age	−0.08 (−0.24, 0.24)	−0.04	0.35	0.05 (−0.08, 0.17)	0.03	0.44
Orphaned child	−0.46 (−1.14, 0.23)	−0.06	0.19	−0.50 (−1.03, 0.03)	−0.09	0.06
Household Characteristics						
Primary caregiver (biological parent)	−0.40 (−1.06, 0.26)	−0.05	0.24	0.63 (−1.14, −0.12)	−0.11	0.02
Number of people in HH	−0.09 (−0.30, 0.11)	−0.06	0.37	−0.13 (−0.29, 0.03)	−0.11	0.12
Number of children in HH	0.10 (−0.18, 0.37)	0.05	0.48	0.06 (−0.16, 0.16)	0.04	0.60
Family Communication						
Frequency of communication	0.05(0.01, 0.09)	0.10	0.02	0.01 (−0.03, 0.04)	0.01	0.81
Level of comfort communicating	0.01 (−0.04, 0.07)	0.02	0.69	0.01 (−0.04, 0.04)	0.02	0.97
Social Support from Multiple Sources (ref. caregiver)						
Teacher	−0.01 (−0.09, 0.07)	−0.01	0.82	−0.04 (−0.10, 0.02)	−0.07	0.22
Friend	−0.07 (−0.15, −0.01)	−0.09	0.05	−0.02 (−0.07, 0.04)	−0.02	0.60
Classmate	−0.09 (−0.17, −0.01)	−0.11	0.03	−0.08 (−0.14, −0.01)	−0.12	0.02
Perceived child-caregiver support	−0.05 (−0.09, −0.01)	−0.11	0.01	−0.02 (−0.06, 0.01)	−0.07	0.12
HIV Disclosure						
Keeping HIV a secret from others	0.20(0.03, 0.38)	0.09	0.02	−0.01 (−0.15, 0.12)	−0.01	0.85
Frequency of HIV status disclosure	0.02 (−0.25, 0.29)	0.01	0.90	0.26 (0.05, 0.47)	0.10	0.02
Disclosure comfort	−0.07 (−0.17, 0.03)	−0.06	0.16	0.04 (−0.04, 0.11)	0.04	0.34
Constant	19.38 (16.02, 22.74)		<0.01	10.62 (8.03, 13.21)		<0.01
F-value(df)	3.27 (15)		<0.01	3.12 (15)		<0.01

B = unstandardized coefficient, β = standardized estimate.

Although non-disclosure could serve as a protective factor against stigma, it may also have implications for access and utilization of HIV care and treatment among adolescent girls (66). Specifically, if other family members and close friends have no knowledge of the adolescent's HIV status, they are less likely to provide appropriate ongoing care and support, including support with their medication adherence.

Third, one of the major barriers to positive and effective parent-child sexuality and HIV communication in SSA is communication style. A review of communication processes and barriers to sexuality communication in SSA demonstrate that parent-child discussions tend to be authoritarian and unidirectional, characterized by vague warnings rather than direct, open discussions, making discussions with children very uncomfortable and ineffective (67). Moreover, studies in Uganda have documented that among caregivers of CLWH, caregiver communication about HIV knowledge and medication is generally low (68, 69). Indeed, our findings indicate that what is important is not the frequency of communication, but rather the level of comfort communicating with the caregiver on sensitive topics, including HIV/AIDS. More specifically, higher level of comfort communicating with a caregiver was associated with how often children discuss their HIV status with other people, including other family members and friends, as well as level of comfort disclosing their status. As such, understanding how parents and caregivers convey sexuality and HIV-related knowledge to their children is important for the success of HIV prevention programming targeting adolescents, including those living with HIV.

Fourth, support from within the school environment, including from teachers and classmates was associated with HIV disclosure and HIV stigma, respectively. On one hand, support from teachers was associated with HIV non-disclosure. It could be that in an attempt to shield children from HIV-related stigma, teachers are likely to advise them not to talk to others about their status (17). On the other hand, support from classmates and friends was associated with low levels of internalized and anticipated stigma. It could be that once adolescents feel supported by their close friends and classmates, they are less likely to worry about being stigmatized. This finding has important implications for schools as potential for stigma-reduction programming targeting adolescents living with HIV in SSA.

Fifth, our findings are consistent with studies that have documented the inverse relationship between stigma and disclosure (70). Specifically, both internalized and anticipated stigma were associated with HIV non-disclosure and low levels of disclosure comfort. Similarly, HIV non-disclosure and frequency of status disclosure were both associated with high levels of internalized and anticipated stigma. Indeed, a study conducted in Uganda among people living with HIV found that HIV internalized stigma significantly reduced the likelihood of disclosure (35). Moreover, this association was amplified by the social distance—as PLWH were more likely to disclose to their close networks (such as family members and sexual partners) compared to distant individuals like public disclosures.

Limitations

Findings presented in this study require careful interpretation in light of the following limitations. First, our study is based on participant self-reports which are prone to social desirability bias. However, given that there was no incentive for participants to overestimate or underestimate their reports, we assume that social desirability was minimal. Second, responses are based on self-reports, yet we know that having multiple sources of information is necessary for triangulation. Specifically, information from teachers, classmates, and parents/caregivers might provide a better picture of the levels of social support and HIV-related stigma experienced by adolescents living with HIV. Third, we utilized a sample of adolescents accessing ART from rural health clinics in our catchment area. Adolescents receiving their medication through other networks i.e. those who depend on their caregivers to get their prescriptions and those in urban areas were not included. As such, our findings may not be representative of all adolescents living with HIV in Uganda. Fourth, measures of stigma did not capture other mechanisms, such as enacted stigma—which involves experiences of discrimination, stereotyping, and/or prejudice that one is subject to due to their HIV positive status. This mechanism is important – with potentially significant implications for children's HIV-related physical health and mental health functioning.

IMPLICATIONS AND CONCLUSIONS

Despite the limitations above, our study findings have significant implications for practice. Schools may be potential for interventions and programs that target stigma-reduction among adolescents living with HIV. Moreover, schools are important because they attract all students who would otherwise not be reached through community interventions. In our sample, 87% of participants were enrolled in school. Thus, schools are a key setting for addressing stigma among children living with HIV. Moreover, schools eliminate barriers that limit access to services, including stigma, cost of treatment and lack of transport to treatment facilities where counseling services are provided. In addition, programs to support and strengthen caregiver communication with their HIV positive children adolescents are urgently warranted. Overall, programming aimed at improving HIV care and treatment outcomes for children and adolescents should consider incorporating strategies that strengthen family communication, especially around HIV knowledge, treatment adherence, disclosure, stigma, and social support, in order to improve HIV health-related outcomes, including overall mental health functioning of HIV positive children and adolescents. In addition, schools may be potential for interventions and programs that target stigma-reduction among adolescents living with HIV in developing countries, especially those in SSA.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

Participation in the study was voluntary. Informed consent and assent were obtained from caregivers and adolescents respectively. The study received Institutional Review Board (IRB) approval from Columbia University (AAAK3852), the Uganda National Council for Science and Technology (UNCST, SS 2969), and Makerere University School of Public Health Higher Degrees, Research and Ethics Committee (210).

AUTHOR CONTRIBUTIONS

PN conceptualized the manuscript, performed statistical analyses and wrote the first draft of the manuscript. WB wrote sections of the manuscript. FS conceptualized, designed, and obtained funding for the study. CD organized the database. OS and MM reviewed the manuscript for intellectual content and made significant additions to the manuscript. All authors contributed to the article and approved the submitted version.

ACKNOWLEDGMENTS

The *Suubi+Adherence* study was funded by the Eunice Kennedy Shriver National Institute for Child Health and Human Development (NICHD, grant R01HD074949, PI: FS). We thank the staff and the volunteer team at the International Center for Child Health and Development (ICHAD) in Uganda for monitoring the study implementation process. Our special thanks go to all children and their caregiving families who agreed to participate in the study. The content of this paper is solely the responsibility of the authors and does not necessarily represent the official views of NICHD or NIH.

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