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Single-Session Digital Intervention for Adolescent Depression, Anxiety, and Well-Being: Outcomes of a Randomized Controlled Trial With Kenyan Adolescents

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Background: Adolescent depression and anxiety symptoms are prevalent in sub-Saharan African countries, yet treatment options are scarce, and stigma limits help-seeking. Brief, computerized single-session interventions (SSIs) that contain empirically supported stigma-reducing elements may help expand access to treatment. We developed and evaluated such an intervention for Kenyan adolescents. ***Method:*** High school students ($N = 103$, age 13–18) were randomized to a digital SSI Shamiri-Digital (*Shamiri* means "thrive" in Kiswahili) or a study-skills control intervention. Shamiri-Digital consisted of reading and writing activities about 3 concepts: growth mindset, gratitude, and value affirmation. Both Shamiri-Digital and the study-skills control condition were delivered electronically in schools. ***Results:*** Compared to the control, Shamiri-Digital produced a greater reduction in adolescent depressive symptoms in both the full sample ($p = .028$, $d = 0.50$) and a subsample of youths with moderate to severe depression symptoms ($p = .010$, $d = 0.83$) from baseline to 2-week follow-up. The effects exceed the mean effects reported in meta-analyses of full-length, face-to-face psychotherapy for youth depression. There were no significant effects on anxiety symptoms, well-being, or happiness. ***Conclusion:*** This is the first report that a brief, computerized SSI may reduce depressive symptoms in adolescents in sub-Saharan Africa. Replication trials with extended follow-ups will help gauge the strength and durability of these effects.

What is the public health significance of this article?
This study provides evidence that a brief, single-session positive-psychology intervention may help reduce the depressive symptoms of adolescents living in sub-Saharan Africa, where there are few mental health professionals and stigma limits help-seeking.

Keywords: depression, adolescents, global mental health, digital mental health, sub-Saharan Africa

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Adolescent depression and anxiety symptoms are prevalent worldwide (Patel & Stein, 2015), contributing an estimated 45% of the overall burden of disease in youths ages 15–19 ("Youth Mental Health Need for Intervention," 2017). Youths in low-income environments, such as sub-Saharan Africa (SSA), are especially vulnerable to these syndromes. In Kenya, for example, studies have found high rates of depressive and anxiety symptoms in adolescents. One study found that 43.70% of school-going youths reported elevated depressive symptoms (Ndetei et al., 2008), and another found the prevalence of elevated depressive symptoms to be 26.40% (Khasakhala, Ndetei, Mutiso, Mbwayo, & Mathai, 2012). A recent study using standardized depression and anxiety measures (Kroenke & Spitzer, 2002; Kroenke et al., 2009; Spitzer, Kroenke, Williams, & Löwe, 2006) with school-attending adolescents in Kenya found that 45.90% exceeded established cutoffs for moderate or severe depression, and 37.99% exceeded cutoffs for moderate or severe anxiety (Osborn, Venturo-Conerly, Wasil, Schleider, & Weisz, 2020). As is often true in epidemiological research, there are cross-study differences regarding the exact prevalence of depressive and anxiety symptoms in Kenyan youths—perhaps due in part to differences in the regions studied, sampling procedures, and measures used—but the studies rather consistently report substantial symptom levels. Investigators have suggested that elevated depression symptoms may reflect in part the financial and social stresses faced by low-income, low-resource families (Osborn, Venturo-Conerly, et al., 2020). Others have suggested that elevated anxiety symptoms may relate partially to the pressure Kenyan students face to succeed in their schoolwork; families sacrifice to pay school fees, and a do-or-die mentality is associated with exam success, upon which further education and career opportunities hinge (e.g., Yara & Wanjohi, 2011).

Many Kenyan youths lack access to effective treatment for their mental health problems. Because most evidence-based therapies are multisession, multimonth treatments delivered by trained professionals (Weisz & Kazdin, 2017), they are not very accessible to youths in low-income countries that have few trained providers (World Health Organization [WHO], 2018). In addition, the social stigma surrounding mental health problems in Kenya—for example, seeing mental health problems as weakness or as evidence of being bewitched by demons—inhibits help-seeking (Getanda, Papadopoulos, & Evans, 2015; Ndetei et al., 2016).

Where such barriers to mental health care exist, alternative forms of intervention may be needed. One option may be computerized interventions that can be self-administered, with content designed to be as stigma-free as possible. Such digital self-help interventions may be particularly useful in low-resource contexts such as Kenya because they can be made readily accessible at low cost, need not require trained professionals (Rochlen, Zack, & Speyer, 2004), and may be designed to confer less stigma than traditional mental health services (Muñoz, 2010). Research on the efficacy of computerized interventions in reducing depression and anxiety symptoms has shown small to medium short-term reductions in these symptoms in general populations (Deady et al., 2017) and in youths (Andrews et al., 2018). The great majority of this work has been conducted in Western countries, but new efforts are under way in non-Western countries, such as India (Michelson et al., 2019; Wasil et al., 2020).

Similarly, interventions that focus on positive human attributes, instead of invoking psychopathology, may circumvent existing societal stigma around mental illness and help-seeking (Osborn, Wasil, Venturo-Conerly, Schleider, & Weisz, 2019; Schleider, Mullarkey, & Chacko, 2020). Some of these interventions are referred to as "wise interventions," interventions that focus on a single belief, skill, or concept (Walton & Wilson, 2018). Some reflect positive-psychology concepts, whereas some resemble core components of traditional evidence-based psychotherapies. They differ from psychotherapy, however, in their broad emphasis on adaptive human characteristics rather than on mental disorders or the treatment thereof. Some of these have been incorporated within single-session interventions (SSIs; Schleider et al., 2020; Schleider & Weisz, 2017). One strength of SSIs is their ability to circumvent the high attrition often seen in multisession interventions (Grime, 2004), and this could make them particularly well suited to SSA countries, where multiple sessions might be difficult logistically. There is some evidence from individual studies that brief interventions focused on positive human attributes (e.g., growth mindset) can be effective in reducing the symptoms of anxiety and depression (e.g., Miu & Yeager, 2015; Schleider & Weisz, 2018); meta-analytic evidence (Schleider & Weisz, 2017) has pointed to beneficial effects of SSIs on youth anxiety symptoms ($g = .58$), although effects on youth depression symptoms ($g = .21$) have been nonsignificant and require further investigation (Schleider & Weisz, 2017).

The broad concept of intervention may encompass both treatment programs for well-defined problems or disorders and prevention programs aimed at forestalling the emergence or exacerbation of problems or disorders. In fact, programs that are universal in their approach—delivered to all youths in a setting rather than solely those with elevated symptoms—may offer significant advantages. Recent research suggests that even mild, subclinical symptoms of mood disorders cause distress and impairment (Ruscio, 2019), suggesting that help might be useful even to individuals at low symptom levels, not just those at clinical severity levels. Moreover, one reason individuals may not seek psychological services is to avoid being labeled as having a mental health problem; universal programs require no such labeling (Clarke, Hawkins, Murphy, & Sheeber, 1993; Corrigan, 2004; Schnyder, Panczak, Groth, & Schultze-Lutter, 2017). Evidence on the effects of universal programs is mixed, but some studies have shown a small to medium short-term reduction in youth depressive and anxiety symptoms (Ahlen, Lenhard, & Ghaderi, 2015; Stockings et al., 2016). Taken together, computerized self-help interventions that are delivered in a single session and consist of stigma-reducing positive psychological content appear to warrant testing with youths in SSA countries such as Kenya, not only as treatments but also as preventive interventions.

We developed a universal, computerized self-help SSI to reduce adolescent depression and anxiety in Kenya. We adapted Shamiri, a three-component intervention that has previously been delivered in person, in groups, over 4 weeks with content that included growth mindset, gratitude, and value affirmation (Osborn, Venturo-Conerly, et al., 2019). Shamiri was universal; it was administered to all students regardless of whether or not they had clinically elevated symptoms of depression or anxiety.

The group-administered Shamiri has shown promising effects on youth depression (d = .32) and anxiety (d = .54) in Kenyan adolescents when delivered by lay counselors (Osborn, Wasil, et al., 2019). In this study, we examined the potential of a digital self-help version of Shamiri.

Shamiri-Digital, like its live, group-administered counterpart, combines three elements from the literature on wise interventions and SSIs. Growth-mindset interventions are designed to strengthen individuals' beliefs that personal characteristics can change and improve (Schleider & Weisz, 2016; Yeager & Dweck, 2012; Yeager, Miu, Powers, & Dweck, 2013; Yeager, Trzesniewski, & Dweck, 2013). Gratitude interventions are intended to promote recognition and appreciation of the good things in one's life (Emmons & Stern, 2013; Froh, Kashdan, Ozimkowski, & Miller, 2009). Value-affirmation interventions prompt participants to identify and reflect on their core values (Cohen, Garcia, Purdie-Vaughns, Apfel, & Brzustoski, 2009; Miyake et al., 2010). Growth-mindset interventions have been shown to improve youth depression and anxiety (Schleider & Weisz, 2018; Yeager et al., 2014), gratitude interventions have been shown to improve well-being and life satisfaction (Emmons & Stern, 2013; Froh et al., 2009), and value-affirmation interventions have been shown to improve academic performance (Cohen et al., 2009; Miyake et al., 2010).

In the present study, we conducted a randomized controlled trial (RCT) of Shamiri-Digital with Kenyan high school students. We hypothesized that adolescents assigned to Shamiri-Digital would experience greater reductions in depressive and anxiety symptoms and greater improvements in overall well-being than youths assigned to an active, digitally administered study-skills control group. Secondary goals for the present study were to (a) gauge whether the intervention improved happiness and optimism and (b) assess intervention impact on high-symptom adolescents who met a clinical cutoff for depression or anxiety.

Method

Trial Design and Registration

The RCT tested the effects of Shamiri-Digital against an active, digital study-skills control group. Participants completed assessments at baseline and 2-week follow-up; a Kenyan government prohibition against non–course-related activity in schools (to protect time for exam preparation and to prevent cheating) took effect 2 weeks after the end of the program, ruling out a longer follow-up. The trial was preregistered at the Pan African Clinical Trials Registry (PACTR; registration number PACTR201906810558181) in accordance with WHO and International Committee of Medical Journal Editors (ICMJE) standards.

Study Setting

The study took place in a mixed-gender (girls > boys—see Table 1 for study gender breakdown) secondary school in Kiambu County on the outskirts of Nairobi. The private (i.e., non–government-operated) boarding school admits low-income students from around Kenya and subsidizes fees (approximately $500 annually) for most students; aggregate data provided by the school administration indicate that 82% of the student body is on full bursary (i.e., no school fees). Such schools are an appropriate context for testing a digital intervention because most such schools in Kenya have computers with an internet connection. In addition, English is an official language in Kenya and the primary language of instruction at all levels of education in Kenya; students are required to be proficient in both written and oral English prior to admission to secondary school.

Participant Recruitment and Resulting Sample

All procedures were approved by the Maseno University Ethics Review Committee (MUERC) in Kenya, prior to the start of data

Table 1
Sample Characteristics at Baseline

Variable	Shamiri-Digital intervention (N = 50)	Study-skills control (N = 53)
Age (M, [SD])	15.36 (1.21)	15.72 (1.21)
Sex		
Female	35 (70.00)	31 (58.49)
Male	15 (30.00)	22 (41.51)
Symptom and wellness levels		
PHQ-8 (M, [SD])	10.60 (5.37)	9.68 (4.69)
GAD-7 (M, [SD])	8.98 (5.12)	8.74 (5.30)
SWEMWBS (M, [SD])	25.78 (4.43)	24.79 (4.51)
EPOCH Optimism (M, [SD])	15.60 (3.55)	14.89 (3.73)
EPOCH Happiness (M, [SD])	13.82 (4.14)	13.02 (4.01
Form		
1	22	21
2	13	14
3	15	18

Note. PHQ-8 = Patient Health Questionnaire–8; GAD-7 = Generalized Anxiety Disorder Screener–7; SWEMWBS = shortened version of the Warwick–Edinburgh Mental Well-Being Scale; EPOCH Optimism = Optimism subscale of the Engagement, Perseverance, Optimism, Connectedness, and Happiness Measure of Adolescent Well-Being (EPOCH); EPOCH Happiness = Happiness subscale of the EPOCH.

collection. Study recruitment took place in June 2019. The study team, comprising student researchers from the United States affiliated with an American nonprofit organization as well as students from Kenyan universities, introduced and described the study as a program intended to improve wellness and academic functioning, at a school gathering with students in Forms 1, 2, and 3 (Grades 9–11), and offered students a chance to participate. Students aged 13–18 were eligible. No exclusion criteria were applied. All interested students provided either informed consent or assent (for adolescents younger than 18). Parental consent was obtained for minors through school administrators per MUERC guidelines. Of the 120 students informed about the study and invited to participate, we obtained consent/assent from 103, who then participated in the study. See Figure 1 for the CONSORT flowchart and Table 1 for sample characteristics.

Measures

Depressive symptoms were assessed using the Patient Health Questionnaire–8 (PHQ-8). The PHQ-8 is the eight-item version of the PHQ-9, a brief diagnostic and severity measure for depression, that excludes the suicidal ideation item (Kroenke & Spitzer, 2002); recent research in Kenyan schools has suggested that school administrators consider the suicidal ideation item potentially stigmatizing and alienating to students (Osborn, Venturo-Conerly, et al., 2020). PHQ-8 and PHQ-9 scores are highly correlated, and the same cutoffs are used to assess the severity of depressive symptoms (Kroenke & Spitzer, 2002). The PHQ-9 has been shown to have adequate internal consistency, test–retest reliability, and discriminant validity within North American samples. The PHQ-8 has also demonstrated adequate internal consistency ($\alpha = .73$) and discriminant validity with Kenyan adolescents (Osborn, Venturo-Conerly, et al., 2020). Cronbach's alpha for the PHQ-8 in the present study was 0.73.

Anxiety symptoms were assessed using the Generalized Anxiety Disorder Screener–7 (GAD-7). The GAD-7 has shown adequate internal consistency ($\alpha = .92$) and convergent, divergent, construct, and criterion validity in samples of North American adolescents (Spitzer et al., 2006). The GAD-7 has also shown adequate internal consistency ($\alpha = .78$) and discriminant validity with Kenyan youths (Osborn, Venturo-Conerly, et al., 2020). In the present study, the Cronbach's alpha for the GAD-7 was 0.82.

Adolescent well-being was assessed using the shortened version of the Warwick–Edinburgh Mental Well-Being Scale (SWEMWBS; Tennant et al., 2007). The SWEMWBS was designed to

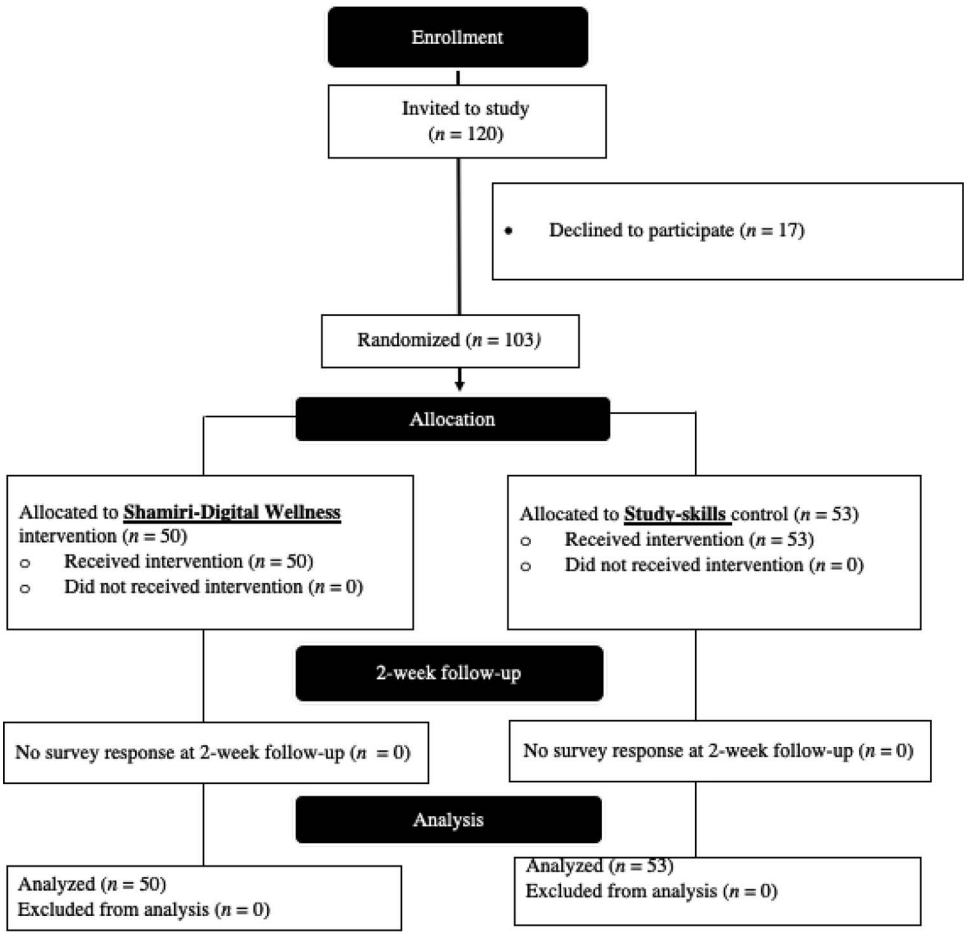

Figure 1. CONSORT diagram showing study flow.

assess psychological functioning and emotional well-being. The scale consists of seven positively worded statements, including, "I've been dealing with problems well" and "I've been feeling useful." Adequate psychometric properties, including construct, content, and criterion validity as well as internal consistency (α = .89), have been documented with a general population in the United Kingdom (Tennant et al., 2007) as well as in Denmark and Norway (Haver, Akerjordet, Caputi, Furunes, & Magee, 2015; Smith, Alves, Knapstad, Haug, & Aarø, 2017). To our knowledge, the psychometric properties of the SWEMWBS have not been documented with Kenyan youths or those in similar countries in SSA. The Cronbach's alpha for the SWEMWBS in the present sample was 0.70.

Self-reported happiness and optimism scores were measured using the Happiness and Optimism subscales of the Engagement, Perseverance, Optimism, Connectedness, and Happiness Measure of Adolescent Well-Being (EPOCH; Kern, Benson, Steinberg, & Steinberg, 2016). The EPOCH assesses five characteristics that predict well-being, health, and similar positive outcomes in adulthood: engagement, perseverance, optimism, connectedness, and happiness. The EPOCH has been validated with a community sample of American and Australian adolescents (Kern et al., 2016). A recent assessment of the psychometric properties of the Happiness and Optimism subscales of the EPOCH with Kenyan youths revealed that both its Optimism and Happiness subscales demonstrated adequate internal consistency (α = .82 and α = .72, respectively). In the present study, Cronbach's alpha for the Happiness subscale was 0.76. However, Cronbach's alpha for the Optimism subscale was .69, which fell below the threshold of .70 for acceptable internal consistency (Nunnally, 1978). As a result, although we report means for the Optimism subscale in study tables, that subscale was not included in further analyses.

In a demographics questionnaire, participants reported their age, gender, and academic level. In a subsequent feedback form, participants rated—on 5-point Likert scales—the degree to which they understood the program activities, could apply the content to their lives, and would recommend the program to Kenyan peers.

Procedure

The intervention was conducted in the computer lab of the Kenyan secondary school. Because only 18 computers were connected to the internet, the intervention was conducted in groups of 18 or fewer students. At the start of each session, participants were randomly assigned to the intervention condition or study-skills condition using a random-number generator embedded in the study website. The study team was thus blind to this allocation.

Participants began by reading information on the purpose of the study, the voluntary nature of participation, and the confidentiality of their responses. Afterward, participants filled out the baseline measures. Then, participants completed the intervention activities for the condition to which they were assigned. At the end of the intervention, participants filled out the feedback form and demographics questionnaire. Students were informed that they could talk to the study staff should they be distressed and that depending on the kind and severity of the distress, the staff would seek help per local customs and regulations in the school. None of the students reported such distress.

In total, participants took approximately 90 min to complete these steps (~30 min for questionnaires, ~60 min for intervention). Participants were given as much time as they needed to complete the activities at their own pace. Two weeks after the intervention, participants completed study measures in their classrooms.

Intervention Arms

Shamiri-Digital intervention. The Shamiri-Digital intervention consists of three modules: growth mindset, gratitude, and value affirmation. In the growth-mindset module, participants learned about the brain's ability to grow in response to challenges in various domains (e.g., academic, interpersonal, and personality traits). Then, participants read a growth testimonial written by a Kenyan peer. Afterward, participants wrote their own growth stories about a challenge they faced and overcame. In the gratitude module, participants learned about the importance of practicing and expressing gratitude. In a "good things" exercise, participants listed three good things in their lives for which they were grateful. In the value-affirmation module, participants learned about the importance of affirming personal values (presented as "virtues," the more common term in Kenya). Participants wrote about a time in which they used their values to guide life decisions. Adaptation of the content and exercises of the Shamiri-Digital intervention is described in detail in an article reporting the efficacy of its group-based counterpart (Osborn, Wasil, et al., 2019). The group-based Shamiri intervention was adapted to the present digital format via an iterative process using (a) the experience and expertise of the first author as a former Kenyan secondary school student, (b) the collective expertise of the authors in intervention design, and (c) feedback from recent Kenyan high school graduates prior to the study. Adaptation was aimed at ensuring the accessibility and usability of the content and the digital format. The program included no audio or multimedia content. More information on Shamiri-Digital, and a link to the full intervention, can be found on the online supplemental materials.

Study-skills control. The study-skills control content was similar to that of a previous study-skills control intervention that had been used in an RCT of the group-based Shamiri intervention (Osborn, Wasil, et al., 2019) but was adapted to fit the digital format. It consisted of two modules: note-taking skills and effective study habits. In the first module, participants learned a step-by-step framework for note-taking. Participants then reflected on how they could use this framework to improve their studying, and they practiced by applying the skill to a brief article. In the module on effective study habits, they learned five study habits they could use to optimize the time spent studying. The structure of the study-skills activities mirrored the structure of the Shamiri activities and required similar effort and time. More information can be found in the online supplemental materials.

Data-Analysis Plan

We used an intent-to-treat approach and included all participants who had been randomized in our data analyses. Linear mixed models were used to compare intervention and control groups for each outcome measure. We ran four linear mixed models for our primary and secondary measures (depressive and anxiety symp-

toms, mental well-being, and happiness). These models were organized to reflect the hierarchical nature of the data. All models included a random intercept that allowed for individual variation at baseline. Time, intervention condition, and their interaction were included in all models. Covariates were age in years and sex. Older adolescents are reported to face increased psychosocial stress, which may exacerbate depressive and anxiety symptoms (Osborn, Venturo-Conerly, et al., 2020; Yara & Wanjohi, 2011), and gender differences in internalizing problems have been documented in Kenyan adolescents (Khasakhala et al., 2012; Ndetei et al., 2008; Osborn, Venturo-Conerly, et al., 2020). Significant ($p < .05$) Time × Condition interactions in predicted directions would indicate that the intervention condition produced more improvement in outcomes across the study period compared with the control. Additionally, we calculated effect sizes (ESs) using differences in means divided by measure standard deviations; these ESs compared mean gain scores (Cohen's *d*) reflecting changes in each outcome from baseline to posttreatment for youths in the intervention versus study-skills control intervention. Statistically significant, positive Cohen's *d* values would indicate greater improvements for intervention-group youths versus control-group youths.

Another secondary goal was to gauge the intervention's effect on self-reported depression and anxiety symptoms of participants who met the conventional clinical cutoff for these symptoms (as determined by a score of either > = 10 on the GAD-7 or > = 10 on the PHQ-8). These cutoff scores were derived from primary care studies in the United States (Kroenke, Spitzer, & Williams, 2001; Kroenke, Spitzer, Williams, & Löwe, 2010) and have been used in recent studies with Kenyan youths (Osborn, Campbell, Ndetei, & Weisz, 2020; Osborn, Venturo-Conerly, et al., 2020) We ran two linear mixed models, similar to the models for the full population described earlier, for participants who met these cutoffs. ESs were also calculated.

Missing data—item-level data, for example, one question on a questionnaire—were imputed five times using the fully conditional specification (FCS) methodology implemented using the multivariate imputation by chained equations (mice) algorithm in R (van Buuren & Groothuis-Oudshoorn, 2011). Only 0.91% of item-level data was missing, and preimputation analyses revealed that data were missing completely at random.

Results

Sample Characteristics

One hundred and three adolescents aged 13–18, mean (M) age (standard deviation [*SD*]) = 15.54 (1.22), participated in this study. There were more females ($N = 66$, 64.08%) than males ($N = 37$, 35.92%). The sample characteristics are shown in Table 1. Fifty adolescents were randomly assigned to the Shamiri-Digital intervention group, M age (*SD*) = 15.36 (1.21), and 53 to the study-skills control group, M age (*SD*) = 15.72 (1.21). Correlations among baseline depressive and anxiety symptoms, as well as mental well-being, happiness, and optimism, are shown in the online supplemental materials. Correlations were in the expected directions.

Primary Outcomes

Intervention effects on adolescent depressive symptoms. The model predicting self-reported depressive symptoms revealed nonsignificant effects for time, condition, and sex but significant effects for Time × Condition and the covariate age (see Table 2). The significant Time × Condition interaction indicated that adolescents in the Shamiri-Digital intervention experienced larger declines in depressive symptoms from baseline to 2-week follow-up than control-group youths, $p = .028$, $d = 0.50$, 95% confidence interval (CI) [.00, 1.6] (see Table 3 and Figure 2). At baseline, 56.00% of the adolescents were above the cutoff for depression severity; after Shamiri, 46.00% were above the cutoff. The corresponding figures for study skills were 52.83% and 50.94%. The significant covariate age ($p = .024$) indicated that younger adolescents reported larger declines in depressive symptoms from baseline to 2-week follow-up than older adolescents.

Intervention effects on adolescent anxiety symptoms. The model predicting self-reported anxiety symptoms revealed nonsignificant effects for time, condition, sex, age, and the Time × Condition interaction (see Table 2). Although adolescents in the intervention experienced a decline in anxiety symptoms from baseline to 2-week follow-up compared with the control-group youths, this decline was nonsignificant, $p = 0.280$, $d = .29$, 95%

Table 2
Results of Mixed Linear Models Predicting Intervention Effects on Self-Reported Depression and Anxiety Symptoms

	Full sample						Elevated-symptoms subsample[a]					
	PHQ-8			GAD-7			PHQ-8			GAD-7		
Predictors	*B*	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*
Intercept	−1.86	4.74	0.695	0.66	4.73	0.890	7.92	5.76	0.172	12.87	6.13	**0.037**
Time	0.45	0.85	0.596	0.29	0.87	0.739	−2.00	1.03	0.056	−3.80	1.07	**0.001**
Condition	1.21	0.95	0.202	0.46	0.95	0.631	1.39	1.11	0.215	−0.06	1.18	0.961
Sex (female)	1.13	0.75	0.137	1.25	0.75	0.097	−0.55	0.99	0.578	−0.14	1.04	0.897
Age	0.69	0.30	**0.024**	0.46	0.30	0.126	0.36	0.36	0.327	0.04	0.39	0.928
Time × Condition (intervention)	−2.70	1.22	**0.028**	−1.35	1.25	0.280	−3.82	1.46	**0.010**	−1.58	1.52	0.304

Note. PHQ-8 = Patient Health Questionnaire–8; GAD-7 = Generalized Anxiety Disorder Screener–7; *SE* = standard error. With the full sample, the model predicting self-reported depressive symptoms revealed nonsignificant effects for time, condition, and sex but significant effects for Time × Condition, whereas with the elevated-symptom subsample, it revealed nonsignificant effects for time, condition, sex, and age but significant effects for Time × Condition. The model predicting self-reported anxiety symptoms revealed nonsignificant effects for time, condition, sex, age, and Time × Condition with the full sample but significant effects for time with the elevated-symptom subsample. Significant gains are highlighted in bold.
[a] The elevated-symptoms subsample is the subsample that endorsed either moderate to severe depression or anxiety symptoms at baseline.

Table 3
Symptom Reduction and Well-Being Improvements From Baseline to 2-Week Follow-Up

Outcome variable	Shamiri-Digital intervention group		Study-skills control group		Cohen's *d*, based on mean gain score [95% CI] (baseline to 2-week follow-up)
	Baseline (*M*, [*SD*])	2-week follow-up (*M*, [*SD*])	Baseline (*M*, [*SD*])	2-week follow-up (*M*, [*SD*])	
Primary outcomes					
Depressive symptoms	10.60 (5.37	8.35 (4.69)	9.68 (4.75)	10.00 (4.65)	**.50** [.00, 1.06]
Anxiety symptoms	8.98 (5.12)	7.92 (4.48)	8.74 (5.30)	9.00 (4.45)	.29 [−.20, .79]
Mental well-being	25.78 (4.43)	25.58 (4.00)	24.79 (4.51)	24.77 (4.59)	−.04 [−.54, .46]
Secondary outcomes					
Optimism	15.60 (3.55)	15.84 (3.12)	14.89 (3.73)	14.96 (3.13)	.05 [−.43 .53]
Happiness	13.82 (4.14)	14.20 (3.65)	13.02 (4.01)	14.02 (4.01)	−.16 [−.61 .29]
Effect on elevated-symptoms subsample					
Depression symptoms	14.43 (3.35)	8.46 (4.98)	13.18 (2.89)	10.64 (4.89	**.83**[a] [.31, 1.35]
Anxiety symptoms	13.33 (3.06)	7.96 (4.35)	13.40 (3.35)	9.61 (5.31)	.39 [−.35,1.12]

Note. For depressive and anxiety symptoms, lower scores indicate better functioning. For the other outcome measures, higher scores indicate better functioning. Where applicable, Cohen's *d* values were corrected (multiplied by −1.0) such that positive values indicate greater improvements for intervention-group participants versus control-group participants. Significant gains are highlighted in bold.
[a] This effect was Hedges $g = .44$ if calculated via the posttreatment mean-comparison method used in recent youth psychotherapy meta-analyses (Eckshtain et al., 2020; Weisz et al., 2017).

CI [−.20, .79] (see Table 3 and Figure 2). At baseline, 48.00% of the adolescents were above the cutoff for anxiety severity; after Shamiri, 40.00% were above the cutoff. The corresponding figures for study skills were 47.17% and 37.34%.

Intervention effects on adolescent mental well-being. The model predicting self-reported mental well-being scores revealed nonsignificant effects for time, condition, sex, and Time × Condition but significant effects for the covariate age. Across condi-

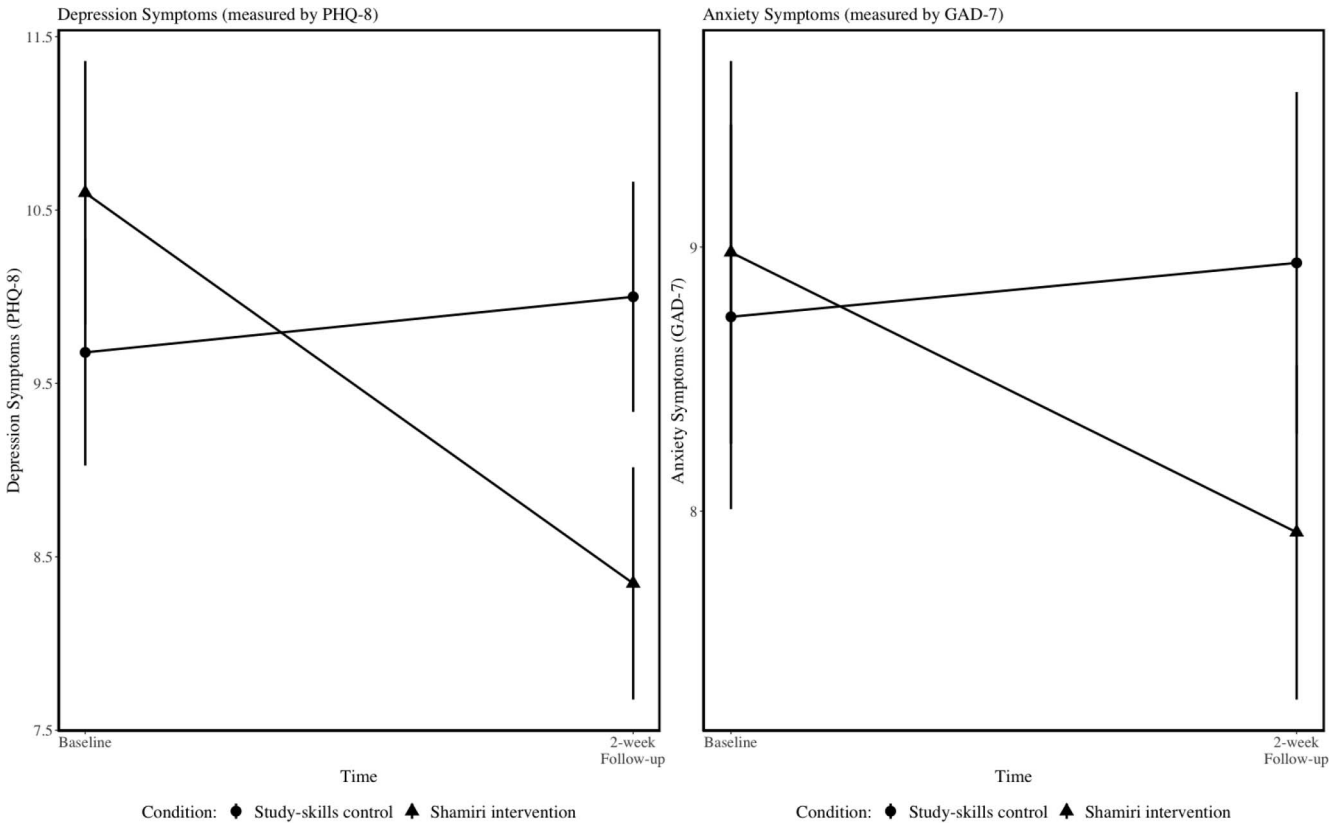

Figure 2. Fitted values showing trajectories of youth depressive and anxiety symptoms for the full sample.

tions, younger adolescents experienced improvements in mental well-being scores from baseline to 2-week follow-up compared with older adolescents. No difference emerged on self-reported well-being between adolescents in the intervention and control groups (see Table 3 and also the online supplemental materials).

Secondary Outcomes

Intervention effects on adolescent happiness. The model predicting self-reported adolescent happiness scores revealed nonsignificant effects for time, condition, sex, and Time × Condition but significant effects for the covariate age. Younger adolescents experienced more improvement in their happiness scores from baseline to 2-week follow-up than older adolescents. No difference emerged on self-reported happiness between adolescents in the intervention and control groups (see Table 3 and also the online supplemental materials).

Intervention effects on depressive symptoms for the subsample with elevated depressive symptoms at baseline. We conducted a subanalysis to gauge intervention effects on the depressive symptoms of a subsample of adolescents who reported elevated depressive symptoms at baseline. We used a cutoff score of $>= 10$ on the PHQ-8 to identify youths who endorsed moderate to severe depressive symptoms at baseline (Kroenke et al., 2001, 2010). Of 103 youths in the study, 56 youths (28 in both Shamiri-Digital and study-skills control) reported moderate to severe depressive symptoms at baseline. The mean baseline PHQ-8 score of youths in this subsample in the intervention group was 14.43 ($SD = 3.35$), whereas the mean score was 13.18 ($SD = 2.89$) in the control group ($t = -1.49$, $p = .141$). The model revealed nonsignificant effects of time, condition, sex, and age but significant effects for Time × Condition. The significant Time × Condition interaction indicated that Shamiri-Digital youths who self-reported clinical depressive symptoms at baseline experienced greater reductions in depressive symptoms from baseline to 2-week follow-up than similar youths in the control group, $p = .010$, $d = .83$, 95% CI [.31, 1.35] (see Table 2 and Figure 3). To situate this effect within the broader youth psychotherapy research literature, we recalculated the ES for the current study using the same calculation method employed in two recent meta-analyses of youth depression psychotherapy RCTs. Those meta-analyses reported mean Hedges $g = 0.29$ in Weisz et al. (2017; 47 youth depression RCTs) and Hedges $g = 0.36$ in Eckshtain et al. (2020; 55 youth depression RCTs). Hedges g for the clinical subsample in the present study was .44.

Intervention effects on anxiety symptoms for the subsample with elevated anxiety symptoms at baseline. We conducted another subgroup analysis to gauge intervention effects on anxiety symptoms for the subsample of adolescents who reported elevated anxiety symptoms at baseline, using a cutoff score of $>= 10$ on the GAD-7 to identify those youths (Spitzer et al., 2006). Of 103 youths in the study, 49 youths (24 in Shamiri-Digital, 25 in study-skills control) reported moderate to severe anxiety symp-

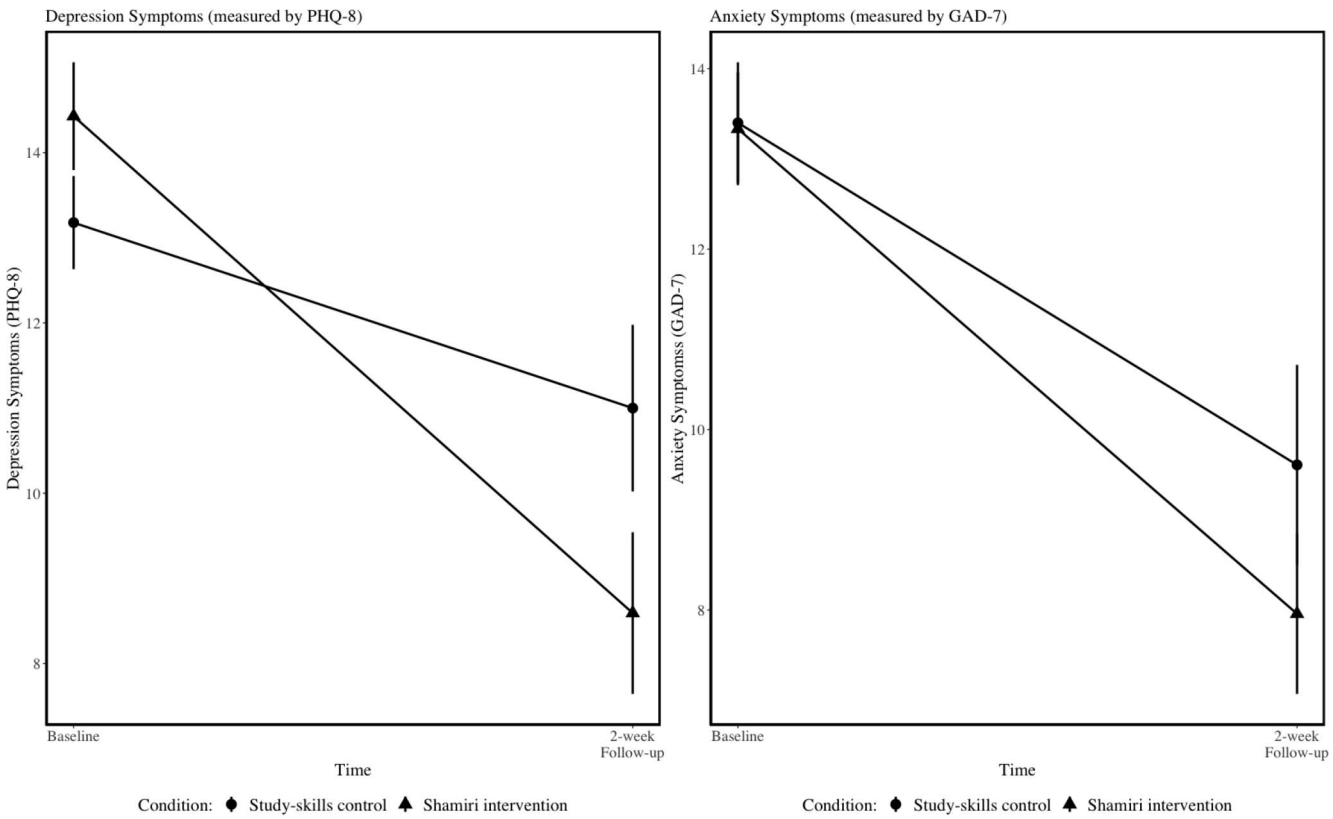

Figure 3. Fitted values showing trajectories of youth depressive and anxiety symptoms for the clinical subsample.

toms at baseline. The mean baseline GAD-7 score of youths in this subsample in the intervention group was 13.33 (SD = 3.06), whereas the mean score was 13.40 (SD = 3.35) in the control group (t = 0.07, p = .940). The model revealed nonsignificant effects of condition, the covariates sex and age, and the Time × Condition interaction but significant effects for time. The significant time effect indicated that regardless of the group into which they were assigned, those youths who showed elevated anxiety at baseline showed declines in anxiety symptoms (p = .001; see Table 2 and Figure 3).

Clinical significances assessed via the reliable-change index. We tested whether outcomes for the full sample or the clinical subsample met the standard for clinically reliable change (Jacobson & Truax, 1991; Wise, 2004). Reliable-change thresholds were calculated using the formula $s\sqrt{(1 - r)} \times 1.96$, using the standard deviation (s) from this sample at baseline and reliability (r) from published psychometric data on Kenyan adolescents for the PHQ-8 and GAD-7 (Osborn, Venturo-Conerly, et al., 2020). Within the full sample, change was limited by lower mean baseline symptom levels and did not reach the reliable-change threshold. However, for the clinical subsample receiving Shamiri, changes in both depression (5.97 vs. reliable-change index [RCI] 4.59) and anxiety (5.37 vs. RCI 4.77) surpassed the RCI; the study-skills control group did not surpass the reliable change-threshold for either depression (2.54) or anxiety (3.79).

Feasibility and Acceptability

Participants rated the degree to which they understood the program on a scale of 1–5. An independent-samples t test revealed high mean ratings and no significant difference in understanding of the program content between the Shamiri-Digital (M = 4.77, SD = 0.49) and study-skills (M = 4.57, SD = 0.94) groups, $t(41.91)$ = 1.01, p = .321. Additionally, participants rated the degree to which they thought they could apply the lessons that they learned in the program. An independent-samples t test revealed high mean ratings and no significant difference in applicability scores between the Shamiri-Digital (M = 4.84, SD = 0.50) and study-skills (M = 4.74, SD = 0.81) groups, $t(40.17)$ = 0.55, p = .586. Participants also rated whether they thought that other Kenyan adolescents would find the program useful. An independent-samples t test revealed high mean ratings and no significant difference in scores between the Shamiri-Digital (M = 4.73, SD = 0.65) and study-skills (M = 4.76, SD = 0.83) groups, $t(52.12)$ = 1.01, p = .878.

Discussion

We developed and tested Shamiri-Digital, a computerized SSI for adolescent mental health. Compared with an active study-skills control group, the Shamiri-Digital intervention produced significant effects on depressive symptoms in the full sample and even more substantial effects in the high-symptom subsample. It may be useful to consider these effects in the context of effects found in prior meta-analyses of youth depression psychotherapy RCTs. The mean ES found in those trials *at immediate posttreatment* was reported as Hedges g = 0.29 in Weisz et al. (2017; 47 youth depression RCTs) and g = 0.36 in Eckshtain et al. (2020; 55 youth depression RCTs). When we applied the same ES calculation method to our data that was used in those two meta-analyses, thus generating Hedges g values, our mean depression symptom ES in Kenya *2 weeks after the end of the intervention* was g = .44 for the clinical sample (those above clinical cutoff at baseline—thus the group most comparable to those treated in the psychotherapy RCTs). Importantly, those previous RCTs in the meta-analyses all involved multisession, in-person psychotherapy (mean: 14 therapy sessions in Eckshtain et al. [2020])—thus, they were markedly more time-intensive and costly than single-session digital Shamiri. Multidecade comparisons of treatment effects for youth depression, anxiety, attention-deficit/hyperactivity disorder (ADHD), and conduct problems and disorders have shown that treatment of youth depression generated the smallest effects (Weisz et al., 2017; 447 studies), with no improvement over time (Weisz et al., 2019; 453 studies). This suggests that new ideas may be needed in youth depression treatment. Although future tests of Shamiri-Digital will certainly be required to probe the robustness of the present findings, the results of this initial study do suggest that—among possible strategies for addressing youth depression symptoms—the notion of using a brief, highly scalable digital intervention that focuses on positive human qualities may warrant attention and further study.

We found nonsignificant differences for Shamiri-Digital versus control on anxiety symptoms, but with a small to medium effect (Hedges g of .24 for full sample, .34 for the elevated-symptom sample) in the predicted direction, suggesting that a larger sample might have produced significant findings. That said, many experts believe that treatments for anxiety must include guided exposures to feared stimuli in order to produce the most substantial benefits (see Weisz & Kazdin, 2017), and effective exposures would be challenging to include in a single-session digital intervention. One other perspective on the anxiety-symptom findings may warrant attention: The pattern shown in Figure 3 suggests that for youths with elevated anxiety at baseline, the slope of anxiety-symptom reduction associated with Shamiri-Digital was actually steeper than the slope of depression-symptom reduction. A primary reason for the absence of a significant Time × Condition effect on anxiety symptoms appears to be that the study-skills "control" intervention was also associated with a steep reduction in anxiety symptoms. As noted in the introduction, some experts have argued that elevated anxiety among Kenyan secondary school students can be linked in part to the high level of pressure they face to succeed in their schoolwork, in a country in which exam success or failure has a massive impact on any further educational and occupational success. Our intervention was delivered prior to the third school term, when exam preparation and pressure are intense. Given this context, it is possible that our study-skills intervention that was intended as a control condition actually addressed a core basis for students' anxiety and may have thus served as an active symptom-related intervention. This suggests that a useful future direction may be testing Shamiri-Digital against a control condition that is less likely to reduce school-related anxiety. This hypothesis must be tempered by the fact that anxiety symptoms in the universal sample who received the study-skills intervention began at a lower baseline level and did not significantly decline from baseline to follow-up; thus, the explanation, if it were valid for the clinically elevated sample, is likely not valid for the full universal sample.

It is interesting that although we found improvements in depressive symptoms, we did not find significant effects of Shamiri-Digital on self-reported well-being or happiness. Because the

psychometric properties of the instruments that we used to measure these constructs have not been extensively validated with Kenyan youths or other youths in similar SSA countries, these findings are certainly not definitive. Future trials with different measures of these positive indicators of mental health may shed further light on whether interventions primarily targeting depressive and anxiety symptoms can produce effects on these constructs as well.

To our knowledge, the present study is the first randomized trial to investigate the efficacy of a brief digital self-help intervention with youths in SSA. As such, it is encouraging that many Kenyan youths found the intervention understandable, applicable, and useful. The low barriers to scaling that the Shamiri-Digital intervention would provide suggest that this intervention, or perhaps others like it, may expand access to help-seeking options for many adolescents in resource-scarce environments. An important aspect of our intervention development was our effort to reduce the risk of activating stigma. It is possible that stigma may have been reduced but not eliminated entirely. In future research, it would be useful to find ways to evaluate the extent to which various interventions evoke versus reduce stigma.

One limitation of the present study was that our sample size was not large enough to detect small to medium differences between conditions. Another limitation is that our study had a relatively brief follow-up period (2 weeks postintervention). We would have preferred a longer follow-up lag time, but the timing was constrained by nationwide Kenyan regulations that prohibit all non–course-related activities during the third and final term of the academic year (August–November), to provide protected time for nationwide school examinations and to reduce the risk of cheating. For comparison, it may also be useful to note that a substantial percentage of youth depression and anxiety RCTs, most conducted in high-income Western countries, have only assessed immediate posttreatment outcomes, with no follow-up assessment (e.g., 40% in a youth depression meta-analysis by Eckshtain et al. [2020]; 48% in the meta-analysis by Weisz et al. [2017]). However, the absence of follow-up, like our 2-week follow-up, leaves the long-term holding power of intervention effects unknown; studies with extended follow-up assessment will be needed to address this important limitation. (This might not have been the case if students had been aware that the intervention was designed to reduce anxiety and depression symptoms, and only one condition was face valid for this outcome, but that was not the case because students were told the intervention was designed to "improve wellness and academic functioning.") A fourth limitation is that, as noted earlier, some of the psychometric properties of the primarily Western instruments used in this study have not been well documented for Kenyan youths. We encourage future research to adopt and use measures that meet sound criteria for appropriateness and psychometric integrity within the cultural context of the research. A fifth limitation is that our intervention was delivered on computers, which are not universally available in Kenyan schools; other platforms, such as smartphones (which could access Shamiri via the internet) or feature phones (for which Shamiri content could be adapted and accessed through Unstructured Supplementary Service Data [USSD], as done currently by e-learning providers in Kenya—see https://enezaeducation.com/), might provide expanded access. One caveat is that most Kenyan schools do not allow students to have phones on campus.

Our findings indicate that brief computerized SSIs may be a promising avenue to investigate as a way of expanding youth mental health care options in low-resource environments such as SSA countries. These findings also support the idea that interventions focused on personal strengths (rather than deficits) may be acceptable and effective with diverse youths, including Kenyan adolescents (and potentially for youths in higher-resource areas as well). We encourage future research on both of these topics because the significant gap between mental health needs and mental health services calls for a wide array of response tools. Low-cost, highly scalable interventions such as Shamiri-Digital may be useful additions if future research supports their effectiveness.

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