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Exploring Naturalistic Diffusion of an Evidence-Based Mental Health Intervention across Peer Networks of Youth in Sierra Leone

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Abstract: Background: Understanding the mechanisms by which evidence-based interventions (EBIs) for mental health are naturally diffused among youth in low-and middle-income countries—particularly those with histories of violence and civil unrest—can illuminate which intervention elements are most transferrable and inform scale-up decisions that support youth adjustment. This study explored the diffusion of an evidence-based mental health intervention—the Youth Readiness Intervention (YRI)—among peer networks of Sierra Leonean youth (aged 18–30) who participated in a trial of the intervention as integrated into youth entrepreneurship programs. Methods: Trained research assistants recruited index participants who had completed the YRI integrated within entrepreneurship training (N = 165) and control index participants (N = 165). Index participants nominated three of their closest peers. Nominated peers were recruited and enrolled in the current study (N = 289). A sub-sample of index participants and peers participated in dyadic interviews (N = 11) and focus group discussions (N = 16). Multivariate regression analysis compared YRI knowledge levels among YRI participants’ peers relative to control participants’ peers. Results: Qualitative findings supported the diffusion of several YRI skills and components across peer networks (i.e., progressive muscle relaxation and diaphragmatic breathing). Quantitative findings indicated that YRI knowledge was significantly higher for YRI participants’ peers ($\beta = 0.02$,

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interventions with demonstrated effectiveness, few are delivered with sufficient breadth to benefit large populations and large geographic areas, and even fewer are disseminated in LMICs [8,9]. There are many barriers to scaling up and sustaining evidence-based mental health interventions, particularly in LMICs with histories of violence and loss; thus, access to evidence-based interventions for vulnerable youth remains limited, and the mental health treatment gap remains high [10,11]. Innovations are needed to improve access to and utilization of evidence-based mental health services that support positive youth adjustment

mental health needs of war-affected Sierra Leonean youth [22]. The YRI is a group-based intervention that integrates core components of cognitive behavioral and interpersonal therapy and can be feasibly delivered by a wide range of lay workers (see Supplementary Table S1). Intervention development was informed by extensive mixed methods research, including a prior longitudinal study with youth affected by conflict, qualitative interviews with community stakeholders, and engagement with a community advisory board [22]. All YRI components were culturally and contextually adapted and reviewed by the community advisory board. The YRI has demonstrated effectiveness in improving mental health, psychological adjustment, and daily functioning among Sierra Leonean youth facing adversity, and youth have reported high levels of satisfaction with the intervention [23,24]. In prior research, YRI participants also reported sharing YRI skills and components (i.e., deep belly breathing) with their friends, suggesting that naturalistic diffusion of YRI techniques has the potential to occur across communities and social networks [25].

The current study explored the process of naturalistic diffusion of YRI components between youth who have participated in the intervention and their peers. Rogers' *Diffusion of Innovations Theory* provides a useful framework for exploring the adoption of evidence-based interventions such as the YRI. According to this theory, diffusion is the process of communicating an innovation through specific channels over time among network members of a social system and investigating the channels and patterns of communication within peer social networks [14,26]. Innovation is defined as an idea or project that is considered new by an individual [14]. This study illuminates how youth receiving the YRI share certain YRI components with their peers and determines which components are most transferrable. For example, youth may share YRI components through knowledge transfer (e.g., demonstration) or through persuasion (e.g., sharing personal testimonies). Additionally, drawing from the *Dynamic Sustainability Framework*, which conceptualizes sustainability as an "adaptation phase" that integrates and institutionalizes interventions within local organizational cultural contexts [27

and collects information on each respondent and their contacts, resulting in a collection of egocentric networks.

Following this design, index participants who enrolled in the current study completed a standard ego network survey in which they nominated three of their closest peers. Nominated peers of both YRI and control index participants were then recruited and enrolled in the current study ($N = 879$). *Inclusion criteria* were (a) being a part of a YRI participant's social network and (b) being male or female aged 18 or over. *Exclusion criteria* were (a) being a current YRI participant or (b) exhibiting severe, active suicidality or psychosis as assessed via the MINI-SCID diagnostic assessment administered by a study social worker. All peer participants provided informed consent to participate in the study.

Participants were located across 3 rural districts (Kono, Koinadugu, and Kailahun) and 16 chiefdoms in the Eastern province of Sierra Leone. Kailahun is the largest district of the three, with a population size of 465,048 and a district-level poverty rate of 60.9%. Kono has a population of 242,722, and Koinadugu's population size is 335,471, with 61.5% and 54% district-level poverty rates, respectively [29]. In Sierra Leone, the designation of "rural" is generally related to a lower population density than in urban areas, and agricultural and informal work is the primary means of income generation. The geographical proximity of households may be more spread out in rural regions, but there can also be an increased sense of social connectedness in the smaller villages.

2.2. Procedures

2.2.1. Quantitative Data Collection Methods

Baseline quantitative data on peers were collected from September 2019 through December 2019. Follow-up data were collected between November 2020 and February 2021. Attrition was 5.33%, with 45 (5.11%) peers being lost to follow-up. The main causes for attrition were difficulties in locating participants. If nominated peer participants were listed by more than one Youth FORWARD index participant, these peers were not treated as duplicated records if they actually pertained to two different ego networks.

2.2.2. Quantitative Measure of YRI Skills and Knowledge

YRI Skills and knowledge levels were assessed with a 24-item multiple-choice scale developed specifically to evaluate knowledge of YRI concepts, skills, and techniques (i.e., diaphragmatic breathing, progressive muscle relaxation problem-solving skills, communication skills, goal setting). Peers completed this measure at follow-up data collection. An example item is the following: "the steps of sequential problem solving include: (a) identify the problem; (b) brainstorm solutions; (c) identify consequences; (d) all of the above." Items are scored as correct (1) or incorrect (0), and an average is calculated to reflect the YRI skills and knowledge score.

2.2.3. Qualitative Data Collection Methods

A subset of YRI index participants and their peers were selected based on a multivariate sampling matrix to participate in qualitative interviews to explore the diffusion of YRI skills and components among peers. Table 1 displays demographic information for qualitative interview participants. A total of 22 semi-structured key informant interviews were conducted with dyads of YRI participants and their selected peers at two time points, first in December 2019 and later in December 2020. Eight focus group discussions were also conducted at two time points, first in September 2019 and later in January 2021. Dyadic interviews and the focus group discussions explored how, if at all, YRI participants shared specific YRI skills and components with their peers; what YRI participants shared, if anything, and what was easier or harder to share; whom YRI participants shared skills and components with, if anyone; and finally, how peers of YRI participants perceived the sharing of skills and components (i.e., whether they were able to comprehend and utilize these skills in their own lives). Both key informant interviews and focus group discussions used a semi-structured interview guide with questions, and potential follow-up

prompts. At the second time point, additional questions were added regarding any changes in sharing and/or use of YRI skills and components.

Table 1. (a) Dyadic interview participants; (b) Focus group discussion participants.

(a)				
Dyad Interviews				
	Individual	Age	Gender	District
Dyad 1	YRI Participant	20	M	Kailahun
	Peer	22	M	Kailahun
Dyad 2	YRI Participant	27	F	Kailahun
	Peer	30	F	Kailahun
Dyad 3	YRI Participant	20	F	Kailahun
	Peer	62	F	Kailahun
Dyad 4	YRI Participant	26	M	Kailahun
	Peer	22	M	Kailahun
Dyad 5	YRI Participant	29	M	Kono
	Peer	22	M	Kono
Dyad 6	YRI Participant	25	F	Kono
	Peer	20	F	Kono
Dyad 7	YRI Participant	25	F	Kono
	Peer	25	F	Kono
Dyad 8	YRI Participant	29	M	Koinadugu
	Peer	32	M	Koinadugu
Dyad 9	YRI Participant	30	M	Koinadugu
	Peer	32	M	Koinadugu
Dyad 10	YRI Participant	20	F	Koinadugu
	Peer	25	F	Koinadugu
Dyad 11	YRI Participant	25	M	Kono
	Peer	23	M	Kono
(b)				
Focus Group Discussions				
Group	District	Individual	Age	Gender
Focus Group 1	Kailahun—Kpeje Bonge Chiefdom	YRI Participant	18	F
		YRI Participant	26	F
		YRI Participant	25	M
		YRI Participant	26	M
		Peer	40	M
		Peer	24	F
Focus Group 2	Kailahun—Penguia Chiefdom	YRI Participant	29	F
		YRI Participant	20	F
		YRI Participant	30	M
		YRI Participant	29	M
		Peer	20	F
		Peer	28	M
Focus Group 3	Kono—Nimiptu]TJitu]TJitu 3			

All interviews were audio recorded by trained research assistants who were fluent in both English and Krio. After data collection, research assistants transcribed each interview and translated them into English.

2.2.4. Ethical Considerations

Trained research assistants read consent forms aloud, explained the risks of involvement to participants, and asked if participants had any follow-up questions. For focus group participants, research assistants explained that all study participants would be asked to keep everything shared in the discussion confidential; however, this could not be guaranteed by the research team. If participants agreed to take part in the study, informed consent was obtained both verbally and in writing via a signature or fingerprint. The study was approved by the Boston College Institutional Review Board and the Sierra Leone Ethics and Scientific Review Committee.

2.3. Data Analysis

2.3.1. Quantitative Data Analysis

Models involving network measures and respondent characteristics are more holistic and can enhance our understanding of the social context [30,31]. In personal network analyses, the nature and pattern of the immediate personal relationships of the respondents (YRI participants or control participants) and their network members (called peers) are investigated. The key components of personal networks include the following: (1) a focal node (respondent), (2) peers reported by the respondents, and (3) the ties between the respondent and their peers [3]. In this study, we deployed a trained enumerator who led the personal network data collection in the field. We adapted and abridged PERSNET, a standard personal network survey instrument routinely used to collect personal network data [30–35]. The PERSNET was administered to the YRI and control index participants

4. Diversity in residential distance: This measures the variation in the residential dis-

(A) (B)

Figure 1. YRI skills and knowledge scores by YRI participation and gender of peers. (A) study arm, (B) Gender of the Peers.

Table 2. Linear regression models predicting YRI skills and knowledge among peers.

	Model 1 (N = 757)	Model 1 (N = 757)
	Coef. (Robust Std. Error)	Coef. (Robust Std. Error)
Study arm (ref: control)		
YRI	0.02 (0.01) *	0.02 (0.01) *
Gender of peers	0.14 (0.01) ***	0.13 (0.02) ***
Proportion homophily of gender		0.00 (0.00)
Gender diversity in peers		0.02 (0.04)
Relationship diversity		0.04 (0.03)
Diversity in residential distance		0.02 (0.05)
Educational status of index participants (ref: never attended school)		
Primary		0.04 (0.02) *
Junior Secondary		0.03 (0.02)
Senior Secondary		0.01 (0.02)

Table 2. Cont.

	Model 1 (N = 757)	Model 1 (N = 757)
	Coef. (Robust Std. Error)	Coef. (Robust Std. Error)
Relationship status of index participants (ref: no partner)		
<i>With partner</i>		0.002 (0.01)
Gender of Index participants		0.01 (0.02)
Age of peers		0.0001 (0.0005)
Age of Index participants		0.001 (0.001)

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

3.2. Qualitative Analyses

3.2.1. Whom YRI Participants Shared with

In dyadic interviews and focus group discussions, YRI participants generally agreed that it was easiest to share with individuals who were the same age. For example, one YRI participant described how it was easiest to share with someone his own age: "It' 4911 Tf(easiest)-

“ They (YRI participants) trained us, they talked to us. I have a wife and there was not a single day that we did not have a fight or quarrel. Now, (my friend) kept talking to me, and encouraging me, and I would never do it again. This is one of the changes that I experienced in my life. They advised us on how to relate with other people- our families- and how to care for the children” . (Male, 22, Kailahun).

Many peers reported they were “going out in the street,” joining gangs or going to clubs less after having YRI skills shared with them. These behaviors were perceived by both peers and YRI participants as detrimental to individuals. For example:

“ I was involved in all sorts of bad habits. I was going out with gangsters, and I have lived with them. They were doing bad things around the town. That time I was tattooing and I had the machine. Thank God that they taught my friend and he shared it with me too. My tattoo machine—I have destroyed it and thrown it away. I am happy that they taught my brother and he too wants to teach me. From that time until now, I have changed” . (Male, 22, Kailahun).

Several other peers provided examples of obeying elders after using YRI skills that were shared with them. One peer described the change in the way he related to elders:

“ When an elder would say something to me, the manner in which I would respond to him will make him feel bad, so we would quarrel . . . So, she came and explained all (the skills) to me and that has directed me about how to behave. So, I say thanks to God” . (Female, 29, Kono).

4. Discussion

The current study explored mechanisms of diffusion of the Youth Readiness Intervention (YRI), an evidence-based mental health intervention, across peer networks of youth in rural, post-conflict regions in Sierra Leone. Quantitative findings suggest a possible pathway of diffusion of YRI skills and knowledge from youth who participated in the YRI to their corresponding peers, as reflected in greater knowledge of YRI skills and components among peers of YRI participants compared with control participants. Qualitative findings on which YRI components were most often shared, how they were shared, and with whom they were shared help illuminate which YRI components are most transferable as well as how they might be most easily diffused to increase penetration of evidence-based mental health interventions and Sierra Leone and other post-conflict settings. Ultimately, this may help support the positive adjustment of a broader segment of youth residing in post-conflict settings.

Peers of YRI participants demonstrated significantly higher levels of knowledge about core YRI components than peers of control participants, suggesting that aspects of cognitive behavioral and interpersonal therapy techniques can be feasibly shared across social networks of youth living in rural, post-conflict settings with limited resources. Findings align with recent social network studies with adolescents, demonstrating that information on health interventions diffuses from participants to their corresponding peers [39,40]. In low-resource settings such as Sierra Leone, one way to maximize the benefit of evidence-based interventions could be by specifically suggesting that intervention participants “spread the word” and encourage their friends and family to apply skills learned from intervention participation. In addition, given that prior research on task-sharing approaches in Sub-Saharan Africa has shown that non-professionals, with appropriate training and support, can effectively deliver clinical interventions [41

of relationship between many index participants and peers, which was a spouse. Given that the age range of our sample was 18–30, and most participants had children and/or spouses or partners, YRI participants may have been more likely to share skills learned with their spouse and/or partner rather than a same-gender peer. Future research might systematically investigate the process of diffusion among romantic partners or household members (i.e., parent-to-child diffusion) in Sub-Saharan Africa. Additionally, quantitative and qualitative findings indicated that diffusion was more likely to occur between same-age

targeted as peer facilitators. Future studies might include a more specific assessment of concepts/constructs related to Rogers' Diffusion of Innovations Theory, such as persuasion, to better understand if and how these constructs facilitated diffusion.

5. Conclusions

The current study used a mixed methods approach to investigate the naturalistic diffusion of an evidence-based mental health intervention among peer networks of youth in a

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