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Factors Associated with Nonspecialist Quality of Delivery within a Family Strengthening Intervention in Rwanda: a Parallel Latent Growth Model

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Abstract
In task-shared, mental health, and psychosocial support interventions, monitoring the quality of delivery (fidelity and competence) of nonspecialist providers is critical. Quality of delivery is frequently reported in brief, summary statistics, and while both fidelity and competence scores tend to be high, rarely have factors associated with quality of delivery in low-resource, mental health, and psychosocial support interventions been examined using inferential statistics. Understanding both modifiable and non-modifiable predictors of quality of delivery is important for adapting training and supervision approaches throughout intervention delivery. In this study, we use a parallel process latent growth model to examine the association of non-modifiable, demographic characteristics of nonspecialists and changes in both fidelity and competence over time. We find that nonspecialist age is significantly associated with higher initial fidelity and competence scores and smaller improvements in fidelity and competence over time, although this finding is interpreted in the presence of ceiling effects. In addition, nonspecialists in a certain district were more likely to have higher initial fidelity and competence scores but also see smaller changes over time. Fidelity and competence were found to significantly co-vary. This study provides conceptual and measurement guidance regarding quality of delivery, suggesting that fidelity and competence are theoretically distinct and must be measured separately, but linked together under the umbrella of quality of delivery. This study also has implications for recruiting, training, and supporting nonspecialists delivering behavioral interventions, suggesting that future implementation teams can further contribute to research on how to better support high-quality training, supervision, and personal and professional growth among the growing nonspecialist workforce globally.

Keywords Fidelity · Competence · Nonspecialists · Low- and middle-income country · Mental health and psychosocial support · Task-sharing

Background

Task-sharing of evidence-based interventions is acknowledged as an effective and widely used strategy for addressing the mental health and psychosocial support (MHPSS) care gap in low- and middle-income countries (LMICs) and has been shown to work well across studies with a diversity of geographical context, MHPSS outcomes, and provider category (Bolton et al., 2023; Kakuma et al., 2014; Singla et al., 2017; World Health Organization, 2007; World Health Organization & United Nations High Commissioner for Refugees, 2015). Task-sharing refers to the use of nonspecialist providers to deliver health-related services that have traditionally been assigned to experts with professional training and certification (World Health Organization, 2007). In LMICs, the dearth of qualified mental health and social service specialists is well documented (Rathod et al., 2017; Thornicroft et al., 2017). Formal training opportunities are inadequate for mental health specialties (Patel et al., 2008; Rathod et al., 2017), while qualified specialists, such as social workers, psychiatrists,

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psychologists, and nurses, often choose to migrate to higher-income countries for better working conditions and higher pay (Oladeji and Gureje, 2016), and governments in LMICs provide very little budget for mental health services for the population (Rathod et al., 2017).

While 83% of the world's population lives in LMICs, these LMICs have historically received only a fraction of the global health resources for mental health (Kola et al., 2021; Liese et al., 2019; Ribeiro et al., 2023), which has led to an increase of disease burden. For example, one out of five persons with depression receives minimally adequate care in high-income countries. In contrast, only one out of 27 receives minimally adequate care in LMICs (Thornicroft et al., 2017). In LMICs, mental health and psychosocial issues account for 7% of the global disease burden (Rehm & Shield, 2019) and 22% of the disease burden in conflict-affected settings (Charlson et al., 2019). Mental health and psychosocial issues in families are exacerbated by ecological factors such as poverty, stigma, and armed conflict (Mesa-Vieira et al., 2022; Osborn et al., 2020). LMICs exhibit many risks and opportunities for protecting the mental health and well-being of children (Yu et al., 2023), particularly during the first 1000 days of a child's life when the brain is rapidly developing (Erskine et al., 2017; Klasen & Crombag, 2013; Patel et al., 2018). Risk and protective factors for child mental health and psychosocial well-being include the home environment, relationships with caregivers, and basic needs such as early stimulation and nutrition (de Leeuw and Malcolm-Smith, 2023; Seya et al., 2023; Draper et al., 2023).

Ingredients for successful task-sharing of MHPSS interventions for families have included training, mentorship, and supervision from intervention experts or mental health specialists (Leocata et al., 2021; McGuillen et al., 2019; Munga et al., 2012; Murray et al., 2011; Rocha et al., 2021). Supervision often entails assessing the nonspecialist quality of delivery with a checklist during in-person monitoring or via audio or video recorders (Kemp et al., 2019). Quality of delivery includes both nonspecialist fidelity and competence. Fidelity refers to adherence to the specific intervention manual (Proctor et al., 2011), while competence refers to the general skills that are relevant across all MHPSS interventions (Kohrt et al., 2015).

Although the assessment of quality of delivery is common and critical for task-shared MHPSS interventions, very few studies report quality of delivery results (Bond et al., 2022; Kanzler et al., 2021; Kohrt et al., 2018; Shahmalak et al., 2019; Singla et al., 2017). When quality of delivery results are reported in studies, they are often reported in the form of brief summary scores or descriptive statistics (Bond et al., 2022). Therefore, although we understand that task-shared interventions are effective (Singla et al., 2017), and training, supervision, and mentorship are good practices that may ensure quality of delivery (Leocata et al., 2021; McGuillen et al., 2019; Munga et al., 2012; Murray et al., 2011; Rocha et al., 2021), very little empirical examination has occurred of factors associated with quality of delivery. This is in part due to the (1) lack of standardized tools or measures for these constructs that can be shared across interventions (O'Shea et al., 2016) and (2) small sample sizes of quality of delivery data in studies. Both barriers inhibit more complex analyses and generalizable findings (Bond et al., 2022).

Factors associated with quality of delivery for nonspecialist-delivered MHPSS interventions may include modifiable factors such as supervision or training, which have been examined only recently in the literature and typically qualitatively (Barnett et al., 2018, 2023; Caulfield et al., 2019; Singla et al., 2017). Training and supervision are critical for promoting quality of delivery (Seegan et al., 2023). No "one size fits all" exists for training and supervision best practices, as each intervention and role nonspecialist providers play is unique and requires some level of tailoring (Barnett et al., 2023).

Overall, factors associated with quality of delivery outside of training and supervision approaches have had insufficient examination. Emerging literature suggests that non-modifiable factors, such as provider demographic characteristics, may play a significant role in quality of delivery as well. Some studies have noted that provider characteristics, such as membership in the same community as intervention participants, increase quality of delivery and intervention effectiveness due to pre-existing trust and partnership (Hoeft et al., 2018; Kohrt et al., 2018). While these studies suggest generally that sharing community characteristics is beneficial for establishing trust and therapeutic alliance in task-shared interventions, there is a dearth of research regarding how, and if, non-modifiable demographic factors contribute to provider effectiveness. The majority of research on the implementation of task-shared MHPSS interventions has focused on intervention modality and modifiable implementation factors such as training and supervision.

The Barriers and Facilitators in Implementation of Task-Sharing in Mental Health Interventions (BeFITS-MH) Framework portrays how implementation barriers and facilitators in task-shared MHPSS interventions impact implementation outcomes (Yang et al., 2024). The BeFITS-MH Framework defines implementation outcomes across a variety of domains, including provider skills and self-efficacy. Fidelity and competence are provider skills that are considered implementation outcomes in the field of implementation science (Proctor et al., 2011). The BeFITS-MH Framework has a corresponding implementation measure that has been validated in LMICs (Yang et al., 2024). On a micro level, measurement domains include provider fit (being able to provide service and helping participants receive services), provider competence (understanding client needs,

sympathizing, communicating well, and tailoring services to clients' unique needs), and provider congruence (being from the same community, demographic factors such as age, gender, social status). Thus, the BeFITS-MH Framework suggests that modifiable factors (such as those included under provider congruence) are instrumental in ensuring implementation quality.

Much conceptual confusion has also occurred between the two distinct aspects of quality of delivery: fidelity and competence (Bond et al., 2022). Both fidelity and competence are critical for quality of delivery and should both be assessed, but it is important that they are measured separately and that their conceptual differences and potential differential impact on intervention outcomes are acknowledged (Fairburn & Cooper, 2011; Murray et al., 2011; Theobald et al., 2018). In a recent systematic review examining fidelity and competence measurement of MHPSS interventions with a behavior change component (Bond et al., 2022), only five of the 16 included studies used a quality of delivery checklist that measured both fidelity and competence (Cross et al., 2015; Johnson et al., 2022; Khan et al., 2019; Puffer et al., 2021; Singla et al., 2020). In the fields of implementation science and global mental health, only recently has competence been separated and operationalized distinctly from fidelity (Kohrt et al., 2015).

As MHPSS programming continues to be task-shared with local communities and delivered by nonspecialist providers, it will become critical to ensure that quality is sustained and that the families and communities receiving MHPSS interventions from nonspecialists are able to continue benefitting. Thus, it is important to understand what enables nonspecialists to become effective intervention facilitators, including non-modifiable factors such as demographic characteristics and role in the community, which have been laid out in the BeFITS-MH Framework. Understanding what enables nonspecialists to become effective facilitators may elucidate areas in which supervisors and study teams can provide greater support to nonspecialists throughout the course of the intervention. In order to support nonspecialists well, quality of delivery must be properly conceptualized or operationalized, and we must understand both modifiable and non-modifiable factors associated with quality of delivery.

Sugira Muryango — A Family Strengthening Intervention in Rwanda

Sugira Muryango is an evidence-based, early childhood development intervention to promote early child development and prevent violence. Sugira Muryango was first implemented as a cluster-randomized controlled trial that tested the intervention on families living in extreme poverty in Rwanda (Betancourt et al., 2018). Compared to the control group, families receiving the Sugira Muryango intervention have had greater improvements in responsive caregiving ($d = 0.87$, 95% CI 0.74, 0.99) and decreases in violent discipline practices (OR = 0.30, 95% CI 0.19, 0.47) (Barnhart et al., 2020; Betancourt et al., 2018, 2020). Furthermore, it was found that although Sugira Muryango had smaller effects on early child development than longer-duration interventions, it is more cost-effective (Desmond et al., 2023).

The structure of Sugira Muryango consists of 12 modules that are delivered to families in a home-visiting format, in addition to two follow-up/booster sessions. The Sugira Muryango components include (1) father engagement, active coaching, and learning on nutrition, health, and hygiene; (2) coaching in responsive parenting and the importance of play; (3) building resilience and coping skills, including a family narrative; (4) building skills in problem-solving and navigating formal/informal resources; and (5) building skills in emotion regulation, stress management, alternatives to harsh discipline, and conflict resolution (Jensen et al., 2023). Though home-visiting, parenting programs in LMICs have been found to be effective (Alves et al., 2024; Efevbera et al., 2018), evidence remains sparse (Alves et al., 2024; Jensen et al., 2021), with only one other identified program including fathers (Tomlinson et al., 2020). Thus, Sugira Muryango is unique in the fact that it engages all caregivers and functions with all family configurations (including foster parents, fathers, and grandparents) and with both male and female caregivers.

Now, Sugira Muryango is being expanded and implemented through the Promoting Lasting Anthropometric Change and Young Children's Development—the PLAY Collaborative, a Hybrid Type II implementation-effectiveness trial (Curran et al., 2012) that intends to (1) scale up the evidence-based intervention to 10,000 Ubedehe 1 households in Ngoma, Rubavu, and Nyanza and (2) assess intervention effectiveness in promoting early childhood development and reducing family violence while strengthening stakeholder engagement through a collaborative team approach (Placencio-Castro et al., 2023; Johnson et al., 2020; Lansford et al., 2022). The program has strong ties to the Rwanda National Government's social protection and policy goals (Government of Rwanda, Ministry of Local Government, 2020).

A government workforce, the Inshuti z'Umuryango (IZUs) meaning "friends of family," serve as nonspecialists delivering the intervention. IZUs are a volunteer, community-based workforce under the Rwandan Ministry of Gender and Family Promotion and the National Child Development Agency who are nominated by their communities. IZUs often hold multiple roles in the communities, such as serving as community health workers or on the National Women's Council. The IZU program was initiated in 2016

and onboarding, training, and capacity strengthening efforts were led by a coalition between UNICEF, Save the Children, and the Rwanda National Child Development Agency, with selected IZU Master Trainers identified in each district to assist. IZUs have been responding to multiple needs in communities, including addressing family conflict, supporting reunification of children separated from their families, and preventing violence against children (UNICEF, 2023).

Prior to delivering Sugira Muryango in their communities, IZUs received an initial 10-day group training from previous expert interventionists, known as the Seed Team, and were monitored and mentored throughout project implementation by designated supervisors, known as cell mentors. While some cell mentors had previous experience delivering Sugira Muryango in the cluster-randomized controlled trial prior to the IZU training, all cell mentors received training on quality monitoring and intervention design. Cell mentors were available by phone to IZUs and met on a weekly basis with all IZUs in their geographic cell. In the weekly meetings, cell mentors provided feedback on ways to improve quality of delivery, helped IZUs problem-solve any challenges that arose during home visiting, and reviewed activities for the upcoming session. IZUs were also equipped to self-monitor by listening back to audio recorders provided during training. Cell mentors were 39% female, the majority with a primary education (59%), and an average age of 34 (interquartile range 29 to 38). Cell mentors were spread throughout each implementation district (24% in Nyanza, 43% in Rubavu, and 33% in Ngoma).

The establishment of the IZU workforce by the Rwandan government, and the study team's decision to partner with the Rwandan government and utilize this workforce to deliver Sugira Muryango, is a result of both the need of task-shared MHPSS interventions in LMICs and the effectiveness of these interventions. Like other LMICs and countries throughout sub-Saharan Africa, Rwanda has an inadequate amount of specialized and accredited health and social service providers (Bunn et al., 2021; Kemp et al., 2019; Rose et al., 2022; Tuyisenge et al., 2018). The IZU workforce has been effectively expanding MHPSS services in their communities, with referrals to specialized providers as necessary (UNICEF, 2023).

Study Objective

As task-sharing evidence-based MHPSS interventions continue to be a widely used and effective strategies for addressing the care gap in LMICs, it will be critical to attain empirical evidence regarding the factors that are related to improvements in quality of delivery over time. This study is guided by the BeFITs-MH Framework that models how provider characteristics are associated with quality of delivery in task-shared interventions. Thus, the purpose of this study is to examine characteristics of IZUs, specifically non-modifiable individual and community-level factors, that are associated with changes in fidelity and competence over time. Supervision and training of nonspecialists and the impact of both on competence and fidelity will be examined qualitatively and reported elsewhere. This current study will also examine how changes in fidelity and competence are correlated with each other. We hypothesize that (1) growth in competence and fidelity over time will be associated with each other; (2) competence and fidelity will increase over time; and (3) provider characteristics (age, gender, district of residence, and education) will be associated with changes in fidelity and competence over time.

Methods

Data Collection and Sampling

Quality of delivery data exists for all 2510 IZU facilitators that actively participated in delivering Sugira Muryango under the PLAY Collaborative implementation science initiative. There were 179 cell mentors responsible for monitoring the quality of delivery (fidelity and competence) of IZUs via an intervention-specific checklist that was collected out during an observational visit of the IZU facilitating a Sugira Muryango module. The minimum number of required observational visits was 2 out of the 12 modules, which was lowered from 6 due to COVID-19 protocols. Nevertheless, a majority (79.3%) of IZUs still received at least 6 in-person observation visits. While it was originally planned that cell mentors would monitor the quality of delivery of randomly selected Sugira Muryango sessions per IZU in their cell, due to COVID-19 and travel logistics that affected feasibility, cell mentors were given the choice to amend their supervision schedule and decide which modules to monitor. Across all 12 modules of Sugira Muryango, there were 1152 to 1526 IZU quality of delivery data points (indicating number of IZUs monitored) per module.

Measures

Outcome Variable

Quality of delivery is assessed via an intervention-specific checklist that measured both the fidelity and competence of nonspecialist providers. Across all 12 modules of Sugira Muryango, 16 cross-cutting, repeated items measured competence, and between one to five fidelity items were unique to each module. Example competence items include "verbal communication skills," "non-verbal communication skills and active listening," and "rapport building and self-disclosure." Example fidelity items include "the IZU

discussed the importance of stimulating a baby's brain by talking to one's baby, touching one's baby, and playing with one's baby," and "The IZU discussed the importance of having a clean, safe, and supportive home environment to support a child's learning." Both competence and fidelity items were rated on a 5-point Likert scale. On the scale, a score of 0 indicated "did not occur," 1 indicated "poor," 2 indicated "needs improvement," 3 indicated "average," and 4 indicated "excellent." These scales were intervention-specific and developed for the purpose of this study. The quality of delivery checklist indicated high internal consistency ($\alpha = 0.93$ for competence). In this study, a summative score of both fidelity and competence was used and then converted to percentages so both scores could be on the same scale and more easily compared. "The quality of delivery checklist indicated high internal consistency ($\alpha = 0.93$ for competence)."

Table 1 Descriptive statistics for covariates used in the study ($N = 2510$)

Variable	*N*	Percentage	*M* (SD)	Range
Gender				
Male	1261	50.2%		
Female	1249	49.8%		
Education				
Primary	1758	71.5%		
Secondary	583	23.7%		
Technical	74	3.0%		
University or higher	45	1.8%		
District				
Rubavu	858	34.2%		
Nyanza	783	31.2%		
Ngoma	869	34.6%		
Age			44.3 (9.83)	22.44–79.91

Independent Variables

Independent variables include education, district, gender, and age. All demographic variables are derived from REDCap as well and inputted from the supervisor, at baseline, based on self-report profiles from IZUs. Education is an ordinal variable, defined as highest degree completed and measured on a 4-point Likert scale of "primary, secondary, technical, and university or higher." Other is also an option, but this response option will not be used for the purpose of this analysis. Gender and district are treated as categorical variables. District is defined as one of the three districts in which IZUs were implementing Sugira Muryango: Ngoma, Nyanza, and Rubavu. The gender variable is dichotomous with two possible values, male and female. Age is a continuous variable, computed based on birth dates provided, ranging from 22.44 to 79.91. See Table 1 for descriptive statistics of independent variables used in the study, and Table 2 for a correlation matrix of all variables used in the study.

Data Analysis

Data was visually examined for patterns of missingness and determined to be missing at random; thus, maximum likelihood estimation was used to estimate the parameters of the models (Pan et al., 2002). It should be noted that missing data for the outcome variables was planned, as IZUs only received a quality of delivery score for the sessions observed by a cell mentor supervisor. Nonetheless, no patterns of missingness were observed across explanatory variables within each module. Individual trajectories were examined to determine if a quadratic or linear model was needed and to portray the mean quality of delivery scores at baseline and changes over time. Ultimately, a parallel process latent growth curve model was used to examine (1) the growth trajectories of both competence and fidelity across the 12 Sugira Muryango sessions and (2) how, if at all, the growth of each quality of delivery outcome (fidelity or competence)

Table 2 Correlation matrix for all variables used in the study ($N = 2510$)

	1	2	3	4	5	6
1. Age	-	$F = 30.97^{c}$ ***	$F = 8.89^{c}$ **	$F = 6.28^{c}$ **	$r = 0.01^{a}$ ***	$r = 0.01^{a}$ ***
2. Gender	$F = 30.97^{c}$ ***	-	$\chi^2 = 0.77^{b}$	$\chi^2 = 13.59^{b}$ **	$F = 1.68^{c}$	$F = 2.21^{c}$
3. District	$F = 8.89^{c}$ **	$\chi^2 = 0.77^{b}$	-	$\chi^2 = 1248.8^{b}$ ***	$F = 239.7$ ***	$F = 81.44^{c}$ ***
4. Education	$F = 6.28^{c}$ **	$\chi^2 = 13.59^{b}$ **	$\chi^2 = 1248.8^{b}$ ***	-	$F = 37.75^{c}$ **	$F = 4.37^{c}$ *
5. Fidelity	$r = 0.01^{a}$ ***	$F = 1.68^{c}$	$F = 239.7^{c}$ ***	$F = 37.75^{c}$ **	-	$r = 0.50^{a}$ ***
6. Competence	$r = 0.01^{a}$ ***	$F = 2.21^{c}$	$F = 81.44^{c}$ ***	$F = 4.37^{c}$ *	$r = 0.50^{a}$ ***	-

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

[a]Pearson correlation

[b]Pearson chi-square test

[c]One-way analysis of variance

is associated with the intercept and slope of the other quality of delivery outcome. In this model, two latent growth models are developed simultaneously, and the growth factors are allowed to co-vary, which provides information regarding the association of growth in fidelity and growth in competence. In each model, the estimates of each independent variable were computed and allowed for examination of the relationship among variables such as age, gender, and district, and the changes in fidelity and competence over time. Regression coefficients were standardized. Model fit was evaluated by four fit indices, the CFI ("comparative fit index"), TLI ("Tucker-Lewis index"), RMSEA ("root mean square error of approximation"), and SRMR ("standardized root mean square residual"). We used the following criteria as a threshold for model fit: CFI and TFI should be greater than or equal to 0.95, and RMSEA and SRMR should be less than or equal to 0.06 (Kline, 2015). Figure 1 depicts the hypothesized model of the current study.

Results

On average, IZUs demonstrated greatest gains in both fidelity and competence scores between modules 1 and 2 (see Figs. 2 and 3). Linear growth was observed for both fidelity and competence trajectories across modules; therefore, we proceeded with linear latent growth models.

Before fitting the full parallel model, we examined both fidelity and competence latent growth models using all covariates in the study in both individual models. Unlike the parallel process model, these models do not account for the covariance of competence and fidelity. Both models demonstrated satisfactory model fit according to relevant fit indices, with the RMSEA and SRMR meeting the threshold and CFI and FLI falling just below the threshold. Thus, we proceeded with running the full parallel latent growth model (Table 3), which examines the effect of each covariate, along with accounting for the covariance between fidelity and competence.

Overall, the relationship among predictor variables and fidelity and competence scores remained similar when the individual models were combined into a parallel model. The results of the parallel process model demonstrated that for each additional year of age, IZUs had, on average, smaller growth in fidelity and competence over time ($\beta = -0.011$, $p = 0.00$; $\beta = -0.009$; $p = 0.009$, respectively) and higher initial fidelity scores ($\beta = 0.005$, $p = 0.039$). Compared to IZUs in Nyanza, IZUs in Rubavu and Ngoma had greater growth in competence ($\beta = 0.462$, $p = 0.000$; $\beta = 0.472$, $p = 0.000$), and IZUs in Rubavu had greater growth in fidelity as well ($\beta = 0.287$, $p = 0.001$). In comparison to IZUs who had completed primary school, IZUs who had completed secondary school had greater initial fidelity scores ($\beta = 1.161$, $p = 0.055$). Gender and education level did not significantly predict either initial starting points for fidelity and competence or changes over time. The model fit decreased slightly as we proceeded with the parallel process model, with only the RMSEA falling within the desired threshold. See Table 4

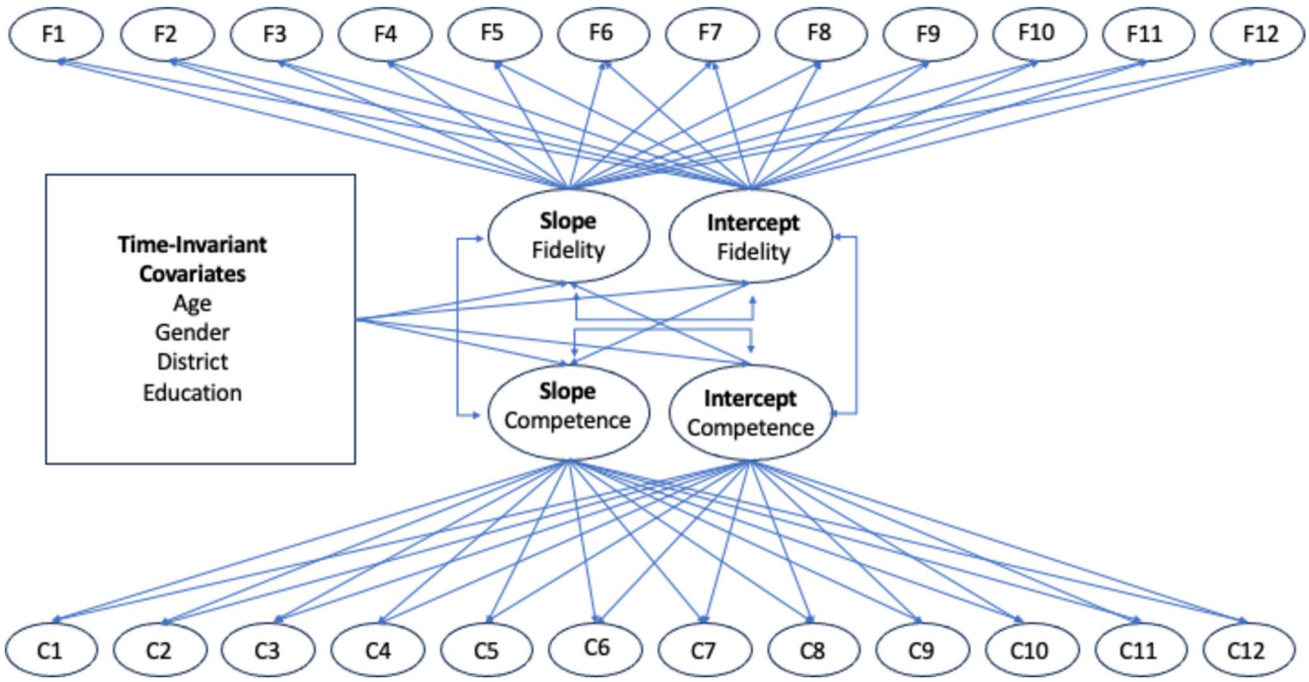

Fig. 1 Hypothesized parallel latent growth model. Note: F, fidelity; C, competence. Numbers 1–12 = module scores

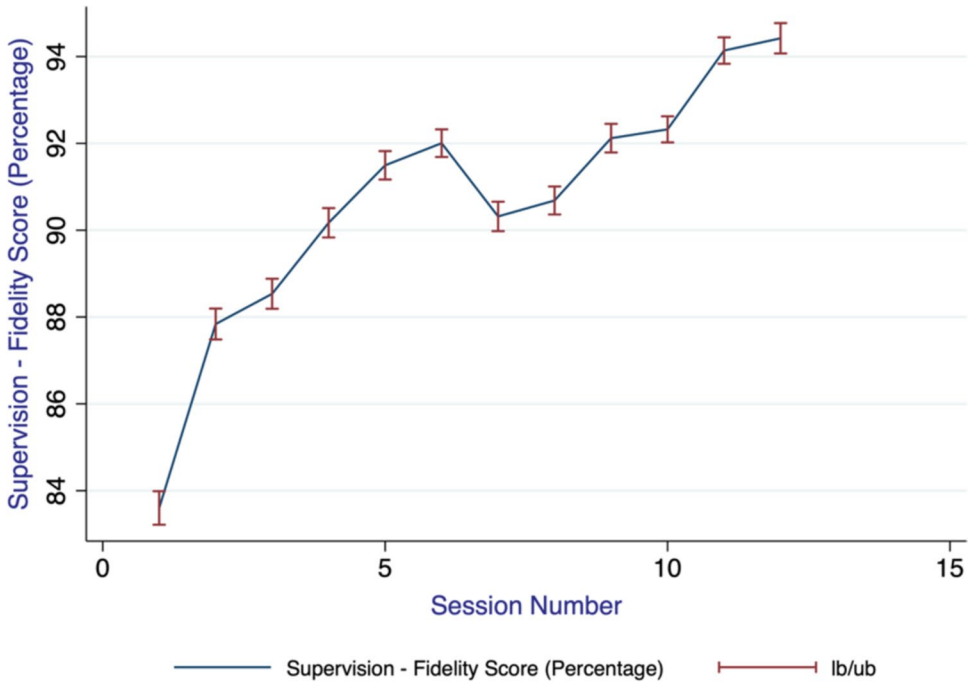

Fig. 2 IZU fidelity trajectories over time

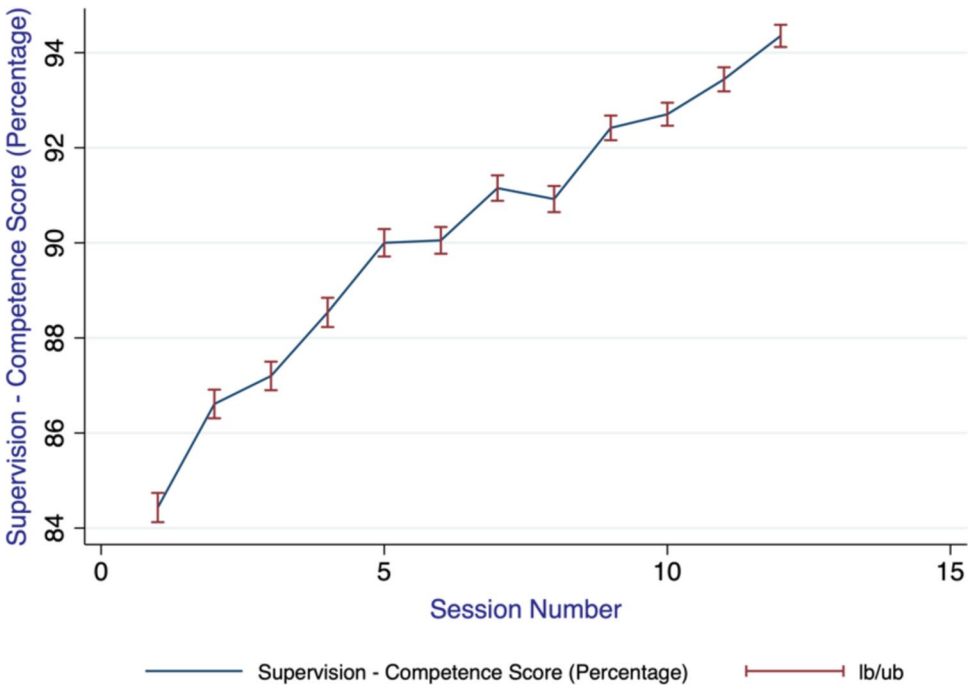

Fig. 3 IZU competence trajectories over time

for full results of the parallel process model, and Table 3 for full results of the individual latent growth models.

The variances for the intercept and slope of fidelity were 0.885 ($p < 0.001$) and 0.961 ($p < 0.001$), respectively, which indicated significant variation across individuals for initial fidelity scores and change rates for fidelity. Likewise, the variance for the slope and intercept of competence were 0.893 ($p < 0.001$) and 0.931 ($p < 0.001$), which indicated significant variation across individuals for initial fidelity scores and change rates for competence scores as well. Higher initial fidelity scores were associated with higher initial competence scores of IZUs, and growth in fidelity scores was associated with positive growth in competence scores (see Table 5).

Table 3 Covariance effect estimates for fidelity and competence latent growth curve models ($N=2510$)

		Intercept				Slope			
		β	b	S.E	p-value	β	b	S.E	p-value
Fidelity	Age	0.005	0.05	0.02	0.036	−0.011	−0.01	0.00	0.001
	Gender								
	Female	−0.044	−0.40	0.46	0.382	0.026	0.02	0.06	0.660
	District								
	Rubavu	−0.736	−6.78	0.60	0.000	0.278	0.257	0.07	0.000
	Ngoma	−0.485	−4.47	0.56	0.000	0.002	0.002	0.07	0.978
	Education								
	Secondary	0.307	2.83	0.53	0.000	−0.121	−0.112	0.07	0.100
	Technical	−0.034	−0.31	1.59	0.844	0.073	0.068	0.18	0.700
	University	0.262	2.42	1.78	0.174	−0.150	−0.139	0.24	0.561
Competence	Age	0.004	0.034	0.03	0.234	−0.010	−0.009	0.00	0.008
	Gender								
	Female	−0.099	−0.929	0.56	0.098	0.105	0.090	0.07	0.170
	District								
	Rubavu	−0.623	−5.847	0.71	0.000	0.401	0.345	0.08	0.000
	Ngoma	−0.552	−5.178	0.67	0.000	0.408	0.351	0.08	0.000
	Education								
	Secondary	0.128	1.204	0.69	0.079	0.032	0.027	0.08	0.735
	Technical	−0.171	−1.604	1.92	0.404	0.122	0.105	0.23	0.653
	University	0.214	2.008	2.50	0.422	−0.264	−0.227	0.37	0.537
Model fit fidelity CFI = 0.87 TLI = 0.86 RMSEA = 0.04 SRMR = 0.05									
Model fit competence CFI = 0.78 TLI = 0.77 RMSEA = 0.03 SRMR = 0.05									

CFI, comparative fit index; *TLI*, Tucker-Lewis index; *RMSEA*, root mean square error of estimation; *SRMR*, standardized root mean square residual

The estimates are unstandardized regression coefficients

Table 4 Covariance and variance effect estimates for parallel process model ($N=2510$)

		Intercept				Slope			
		β	b	S.E	p-value	β	b	S.E	p-value
Fidelity	Age	0.006	0.05	0.02	0.039	−0.012	−0.01	0.00	0.001
	Gender								
	Female	−0.365	−0.37	0.46	0.426	0.019	0.016	0.06	0.299
	District								
	Rubavu	−0.788	−6.73	0.60	0.000	0.287	0.25	0.07	0.001
	Ngoma	−0.519	−4.43	0.56	0.000	−0.001	−0.00	0.07	0.991
	Education								
	Secondary	0.325	2.78	0.53	0.000	−0.113	−0.10	0.07	0.149
	Technical	−0.052	−0.44	1.60	0.783	0.086	0.07	0.18	0.677
	University	0.279	2.38	1.80	0.186	−0.132	−0.11	0.24	0.641
Competence	Age	0.004	0.04	0.03	0.223	−0.011	−0.01	0.00	0.009
	Gender								
	Female	−0.115	−0.94	0.56	0.091	0.009	0.10	0.07	0.129
	District								
	Rubavu	−0.718	−5.86	0.70	0.000	0.462	0.37	0.08	0.000
	Ngoma	−0.647	−5.28	0.67	0.000	0.472	0.37	0.08	0.000
	Education								
	Secondary	0.161	1.31	0.69	0.055	0.021	0.02	0.08	0.833
	Technical	−0.136	−1.11	1.91	0.560	0.058	0.05	0.23	0.845
	University	0.259	2.11	2.47	0.390	−0.342	−0.27	0.36	0.452
Variances	Fidelity	0.885	64.40	4.25	0.000	0.961	0.71	0.06	0.000
	Competence	0.893	59.52	6.11	0.000	0.931	0.59	0.10	0.000
Model fit CFI = 0.80 TLI = 0.79 RMSEA = 0.04 SRMR = 0.08									

CFI, comparative fit index; *TLI*, Tucker-Lewis index; *RMSEA*, root mean square error of estimation; *SRMR*, standardized root mean square residual

The estimates are unstandardized regression coefficients

Table 5 Covariance and variance estimates for parallel process model

		Estimate	S.E
Covariance	$I_{(Fidelity)} \leftrightarrow I_{(Competence)}$	46.29***	3.68
	$S_{(Fidelity)} \leftrightarrow S_{(Competence)}$	0.24***	0.04
	$I_{(Fidelity)} \rightarrow S_{(Fidelity)}$	−2.86***	0.49
	$I_{(Competence)} \rightarrow S_{(Competence)}$	−2.09**	0.71
Variances	$I_{(Fidelity)}$	64.40***	4.25
	$I_{(Competence)}$	59.52***	6.11
	$S_{(Fidelity)}$	0.71***	0.06
	$S_{(Competence)}$	0.59***	0.10

***$p < 0.001$

I, intercept; *S*, slope

Double-headed arrows represent correlations and single-headed arrows represent regression effects

Discussion

Findings suggest that IZU competence and fidelity are closely related and significantly co-vary: on average, the higher the initial fidelity score for IZUs, the higher their initial competence scores are as well. In addition, as IZUs improve in their fidelity over time, their competence scores also improve, suggesting that the two concepts are closely related and influence each other's growth trajectories. This finding confirms our initial hypotheses that fidelity and competence will be associated with each other, and that growth will improve over time.

As the field of implementation science continues to expand in its understanding of quality of delivery. Our research sought to add conceptual clarity in this endeavor and provides evidence that fidelity and competence are two distinct concepts that are highly related and yet unique and critical component of delivery quality. It would be erroneous to interpret their correlation as evidence that fidelity and competence can be measured and assessed interchangeably or in lieu of one another. While this study contributes empirical evidence that fidelity and competence are indeed closely associated with each other in Sugira Muryango, prior theory and conceptual work have established that fidelity and competence are both critical to overall quality of delivery, and, while they influence each other, they are discrete concepts (Ottman et al., 2020; Fairburn & Cooper, 2011; Kohrt et al., 2015; Proctor et al., 2011). Lessons regarding conceptualization and measurement of covarying concepts can be learned from the study and clinical practice of anxiety and depression symptoms. Anxiety and depression are clinically distinct concepts, yet are known to co-vary in regard to symptomatology and as seen empirically in statistical analysis (Derogatis et al., 1974; Kalin, 2020). Simms and colleagues state that the common underlying factor of both anxiety and depression is psychological distress (Simms et al., 2008). Just as anxiety and depression are distinct concepts, linked under the overarching concept of psychological distress, fidelity and competence are linked under delivery quality.

This study also examined non-modifiable demographic predictors (district, gender, and age) of IZU fidelity and competence. Education and gender did not significantly predict either initial starting points in fidelity and competence scores or growth over time. Because a strong majority (71.5%) of IZUs had a primary education and no further education, and the intervention was designed to be implemented by nonspecialists without advanced degrees, additional education was likely unnecessary or irrelevant for delivering Sugira Muryango with quality, as supported by the findings presented here. Furthermore, female IZUs in this study did not have significantly different competence or fidelity scores compared to their male counterparts. This finding makes sense given the Rwandan context and the decades of gender-transformative work on behalf of the Rwandan government and multiple Rwandan social service organizations (Carlson & Randell, 2013; McLean et al., 2020; Ministry of Gender & Family Promotion, 2021; Stern et al., 2018). Thus, male and female IZUs may have had similar access to resources for learning and support, and similarly, male IZUs may have been equally familiar and comfortable with caregiving practices, both of which may have been less likely in other intervention contexts (Okelo et al., 2022; Sarin & Lunsford, 2017). In addition, the design of Sugira Muryango may have contributed to this finding. The research team intentionally utilized an implementation model that relied on women in positions of leadership, which ensured that cell mentors; members of the training team; and members of leadership teams at cell, district, and national levels had equal gender representation. Moreover, Sugira Muryango's theory of change targets secondary caregivers, which largely consist of fathers (Johnson et al., 2020). Therefore, IZUs were working with both same and opposite-gender caregivers in the homes regardless of their gender.

The results of the parallel latent growth model revealed two significant predictors for growth in fidelity and competence: IZU age and IZU district of residence. Older IZUs are more likely to have higher initial fidelity and competence scores; however, their growth over time is slower than that of their younger counterparts. While this finding does align with broader adult learning theory, which suggests that as adults age, physical limitations may affect their overall ability to learn (Knowles, 2014), it could be that older IZUs had higher initial fidelity and competence scores due to their additional experience but had lower rates of change as a result of ceiling effects (less room to grow) (Feng et al., 2019). The mean age of IZUs was 44 with significant variability in age (SD = 9.83, age range 22–79). The upper quartile of age ranged from 50 to 79.

Additionally, IZUs in Ngoma and Rubavu districts had lower initial fidelity and competence scores but grew at a faster rate compared to their counterparts in Nyanza. The University of Rwanda has a campus located in a district adjacent to Nyanza district; therefore, this finding could be due to additional resources for further educational support that exists outside of the intervention in Nyanza. In addition, qualitative data from the Sugira Muryango cluster-randomized trial indicated that community-based volunteers in Nyanza had received previous training on HIV and community reconciliation, which helped them to feel prepared when entering Sugira Muryango training (Bond et al., manuscript under review). This could be the case for IZUs in Nyanza as well. The higher rates of growth for IZUs in Rubavu and Ngoma may also be due to ceiling effects for IZUs in Nyanza, which suggests that there may have been less room for growth for IZUs who started with higher competence and fidelity.

Findings from future analyses exploring factors associated with fidelity and competence should also be interpreted in the context in which that intervention took place. For example, while district significantly predicted IZU fidelity and competence scores in Rwanda, this may not be the case in other programs, countries, and regions. Utilizing qualitative data to supplement statistical examination of factors that contribute to fidelity and competence could unpack the above results and aid our understanding of which results may be generalizable and which may not. To illustrate, while research regarding factors associated with fidelity and competence remains rare in the field of global mental health, individual characteristics of providers have not predicted quality of delivery in school-based programming (Domitrovich et al., 2019). More exploratory research should be done in the field of global mental health to generate enough empirical evidence to examine patterns of when and where individual-level characteristics influence quality of delivery.

While future research is certainly needed to confirm and explain patterns observed in this study, important practice implications can be noted. (1) Careful examination of any differences in resources that exist across districts can inform training and supervision approaches for nonspecialists, such as IZUs. If efforts can be made to identify what district-level tools and resources lead to higher initial fidelity and competence, these tools and resources could be replicated across districts prior to training and intervention delivery. (2) Strategies such as a pre-test to examine existing areas of strength and weakness for nonspecialists could inform more targeted training approaches, which could in turn lead to less variance in initial starting points of both fidelity and competence. (3) Furthermore, supervisors can make efforts to provide older nonspecialists with additional support as needed, such as more training in technology. The administration of a pre-test or qualitative data collected from both nonspecialists, and their supervisors, can inform on the specific needs that older IZUs have compared to their younger counterparts.

Limitations

This study has limitations. The first limitation is regarding the quality of deliver instrument itself: First, there are very few fidelity items per module (between one to five items), and many aspects of adherence to the Sugira Muryango intervention are not able to be captured in our computation of fidelity. This also may affect the variability that exists in fidelity data, as mean scores were generated across modules. In addition, the competence section of the quality of delivery checklist was originally conceptualized as cross-cutting quality of delivery components rather than competence skills. As such, there are several items that arguably do not fit the standard definitions in the literature on competence and may fit better into a fidelity section of the quality of delivery checklist. Third, the Likert scale response options ranged from 0 to 4, with "average" being a score of 3. This may have caused ceiling effects and limited the variability in the data.

The second limitation is regarding the quality of delivery tool raters. Cell Mentors were responsible for filling out the quality of delivery tool for specific IZUs that they had supervision responsibility for. Due to time and resource restraints, only the Cell Mentor supervisor filled out the tool per each quality of delivery session score. Each Cell Mentor was trained on the use of the tool; however, a single reporter may limit the reliability of the tool as inter-rater reliability was not established in the study.

The final limitation is due to the COVID-19 pandemic. In response to movement restrictions put in place by the Rwandan government and potential lockdowns due to outbreaks or individuals becoming infected and needing to isolate, the required number of in-person supervision sessions was reduced from six to two. While the majority of Cell Mentors (79.3%) were able to visit each IZU six times despite the restrictions, not all were, and this resulted in in less data that could have been longitudinally modeled in this study.

Conclusion

Overall, IZUs see positive, linear growth in fidelity and competence over time when delivering the Sugira Muryango intervention. District and age are factors that significantly predict fidelity and competence trajectories. While fidelity and competence co-vary, these terms are theoretically distinct and must be equal components, measured together, when computing quality of delivery scores. In the field of global mental health, more research is needed to confirm

patterns of which factors are generally associated with quality of delivery. Studies must move beyond reporting reliability statistics and first ensure that quality of delivery tools assesses both fidelity and competence. More research is needed to examine modifiable and non-modifiable factors associated with quality of delivery and begin to identify patterns in LMICs.

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Data availability Data from this study can be made available upon request; the Sugira Muryango is available under a free licensing agreement and can be made available upon request.

Declarations

Ethics Approval This study received approval from the Boston College Institutional Review Board and the Rwanda National Ethics Committee.

Consent to Participate All participants enrolled in the study provided informed consent. Study team members read the consent forms aloud to participants in the local language and provided a chance for participants to ask questions before consenting. Verbal and written consent (in the form of a signature or a fingerprint) was received from all participants involved in the study. Consent forms were approved by the Boston College Institutional Review Board and the Rwanda National Ethics Committee.

Conflict of Interest The authors declare no competing interests.

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