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Authors

Li, L
Liang, LJ
Ji, G
et al.

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Li Li, Li-Jung Liang, Guoping Ji, Jie Wu & Yongkang Xiao

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ORIGINAL PAPER

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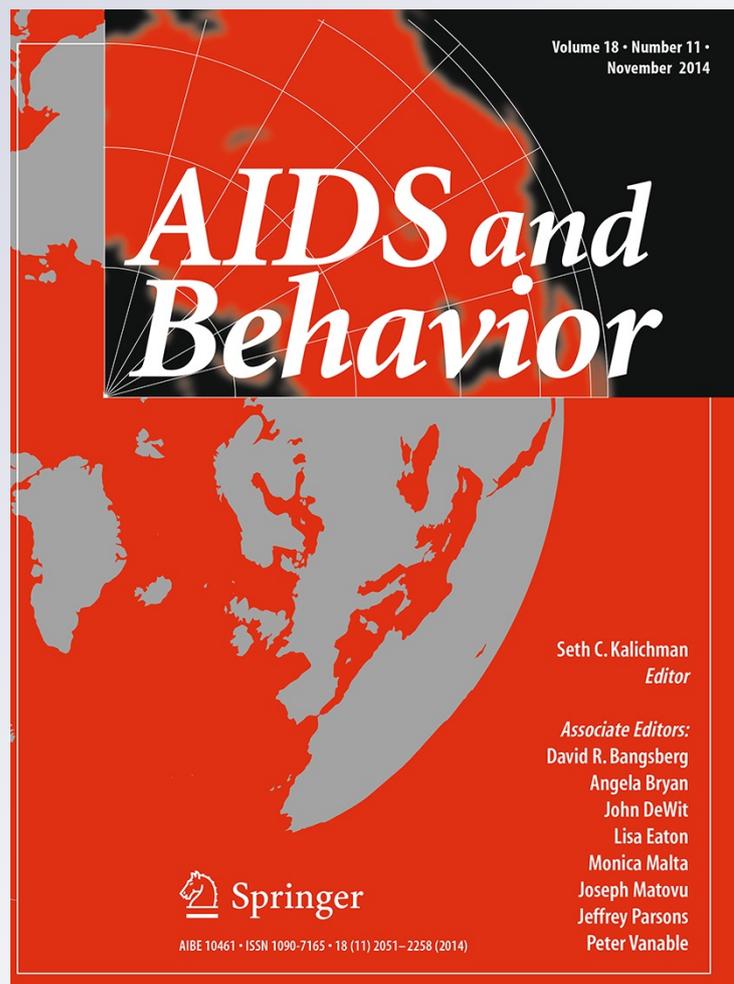**Abstract** This study assesses intervention outcomes in children's self-esteem, perceived parental care, and problem behavior and their potential connections to intervention outcomes in depressive symptoms and family functioning reported by parents living with HIV (PLH) and family members. A total of 79 families were recruited from Anhui province, China. The intervention was delivered at the individual, family and community levels. Face-to-face interviews were administered at baseline, 3 and 6 months. A mixed-effects regression model was used to assess the intervention effect on the improvement of children's reported self-esteem, parental care, and problem behavior. To further investigate the association between the parental measures and their children's outcomes, we added parental measure as a time-varying covariate to explore whether the intervention effect on children was influenced by the parental measures. We observed some intervention effects related to children's psychological measures accompanied by the improvement in mental health of PLH and family members. Our study findings highlight the importance of empowering families as a whole to confront HIV related challenges and the need to develop child-adequate and age-specific intervention strategies.

L. Li (✉) · J. Wu
Semel Institute for Neuroscience and Human Behavior, Center for Community Health, University of California at Los Angeles, 10920 Wilshire Blvd., Suite 350, Los Angeles, CA 90024, USA
e-mail: lililili@ucla.edu

L.-J. Liang
Department of Medicine Statistics Core, University of California at Los Angeles, Los Angeles, CA, USA

G. Ji · Y. Xiao
Anhui Provincial Center for Disease Control and Prevention, Hefei, China

Introduction

By the end of 2010, an estimated 34 million people were living with HIV globally, including 3.4 million children less than 15 years old [1]. In a 2009 report, UNICEF estimated that 15 million children under the age of 18 have lost one or both of their parents to AIDS [2]. As improved treatment strategies continue to prolong the lives of parents living with HIV (PLH), more children will have to adopt caretaking roles and learn to cope with shifts in family structure, financial deprivation, and stigma. Moreover, children living with PLH are more likely to have emotional or behavioral problems that lead to substance abuse, depression, low self-esteem, poor performance in school, or delinquency [3–10].

Children affected by HIV/AIDS experience complex problems specific to their psychosocial well-being [11–16]. Several studies have reported that having a parent with HIV is associated with depressive symptoms and acting-out behaviors [3, 17–22], and many researchers have noted that a stressful family environment can interfere with parent–child bonding and have long-term psychological consequences for children [23–25]. Some previous studies emphasized the role of family within the broad social context that shapes child socialization and development [26–28]. By intervening at the family level, parents could continue efforts after intervention programs complete to enhance the likelihood of sustained behavioral changes of children [29]. Therefore, it is appropriate to implement interventions at the family level that not only target HIV-affected children, but also focus on the connection between PLH psychological status and its impact on children's mental health or behavioral issues.

Table 1 Sample characteristics and baseline measures

	Intervention N = 38	Control N = 41
Child characteristics		
Age (%)		
6–12	20 (52.6)	13 (31.7)
13–18	18 (47.4)	28 (68.3)
Male (%)	22 (57.9)	20 (48.8)
Child outcome (mean ± SD)		
Self-esteem	29.4 ± 4.37	30.5 ± 2.95
Parental care*	9.78 ± 1.96	10.7 ± 1.35
Problem behavior	2.26 ± 2.52	2.58 ± 1.97
Parents and family characteristics		
Age (mean ± SD)		
PLH	41.9 ± 7.77	40.2 ± 5.22
Family members	40.9 ± 8.52	40.8 ± 11.6
Male/female (%)		
PLH	26 (68.4)/12 (31.6)	24 (58.5)/17 (41.5)
Family members	11 (29.0)/27 (71.0)	16 (39.0)/25 (61.0)
Education (%)		
PLH		
None	7 (18.4)	4 (9.76)
1–5	23 (60.5)	21 (51.2)
6 or more	8 (21.1)	16 (39.0)
Family members		
None	11 (29.0)	11 (26.8)
1–5	17 (44.7)	12 (29.3)
6 or more	10 (26.3)	18 (43.9)
Number of children		
1	17 (44.7)	18 (43.9)
2	19 (50.0)	20 (48.8)
3 or more	2 (5.26)	3 (7.32)

* $P < 0.05$

This pilot study explores the links between children and their family members while assessing the efficacy of an intervention that targets PLH, other adult family members, and children simultaneously. Analyses will examine intervention outcomes in children's self-esteem, perceived parental care, and problem behavior and their potential connections to intervention outcomes in depressive symptoms and family functioning reported by PLH and family members.

Methods

Participants

Data were collected from August 2009 to April 2010 in Anhui Province, China. The inclusion criteria for participation included persons: (1) with confirmation of an AIDS diagnosis or HIV-positive status; (2) having a sero-negative family member living at home; and (3) having at least one child aged 6 to 18 years living with a PLH participant. We used family as a unit for enrollment. With the assistance from village health workers, project recruiters approached potential participants. Those who agreed to participate were asked to invite an adult family member who was considered their primary caregiver and children in the family to join the study. All adult family members were contacted after obtaining permission from the PLH participants; all children were contacted after obtaining informed consent from the PLH participants. Participants were informed of their ethical rights, including the right to withdraw from the study, and that their participation would not affect their family members' care or services. Following the informed consent process, face-to-face interviews were conducted in the private room of a local village clinic. All procedures and forms were reviewed and approved by the Institutional Review Board of the University of California, Los Angeles, the Institutional Review Board of the Anhui Province Center for Disease Prevention and Control, and the Medical Institution Review Board of Anhui Medical University.

Study Design

An intervention pilot with a cluster randomization design was used in the study. A total of 79 families from four villages were recruited. The village, not the family, was used as the unit of randomization. All participating families included one PLH and one sero-negative family member, and one child. Participants in both the intervention and control conditions were assessed at baseline and 3- and 6-month follow-up assessments. Intervention outcomes were assessed by comparing the changes in outcome measures, between the intervention and the control conditions, over a period of 6 months.

Intervention

Together for Empowerment Activities (TEA) is a multi-level intervention that focuses on a family's capacity to overcome the impacts of living with HIV. The development and delivery of the intervention has been reported elsewhere [30]. The TEA intervention includes three levels of activities: (1) TEA Gathering consists of six small group sessions for PLH and family members after a preparation section; (2) TEA Time includes six home-based family activities with all family members after each TEA Gathering session; and (3) TEA Garden has three community events that build social integration. Although children do not directly participate in the TEA Gathering group

Table 2 Mixed-effects regression models on child outcomes

| Outcome measures | Age group | Comparison | Change in child outcome from baseline | | | | | |
| | | | 3-month | | | 6-month | | |
			Estimate	SE	P	Estimate	SE	P
Self-esteem	6–12	Control	0.769	1.145	0.5030	0.655	1.287	0.6118
		Intervention	1.850	0.923	0.0471	2.396	0.938	0.0117
		INT−CTL	1.081	1.471	0.4639	1.742	1.592	0.2759
	13–18	Control	0.064	0.809	0.9373	0.115	0.784	0.8837
		Intervention	2.375	1.011	0.0202	1.890	1.016	0.0650
		INT−CTL	2.311	1.294	0.0764	1.775	1.283	0.1688
Parental care	6–12	Control	0.077	0.461	0.8679	−0.235	0.521	0.6522
		Intervention	1.100	0.372	0.0037	1.181	0.378	0.0022
		INT-CTL	1.023	0.593	0.0866	1.416	0.644	0.0295
	13–18	Control	0.038	0.331	0.9076	0.693	0.322	0.0327
		Intervention	0.235	0.409	0.5663	0.898	0.411	0.0308
		INT−CTL	0.197	0.526	0.7091	0.204	0.522	0.6962
Problem behavior	6–12	Control	−1.231	0.457	0.0079	−1.306	0.521	0.0133
		Intervention	−0.300	0.368	0.4168	−0.572	0.375	0.1290
		INT−CTL	0.931	0.587	0.1151	0.734	0.642	0.2544
	13–18	Control	−0.447	0.326	0.1722	−0.523	0.319	0.1032
		Intervention	−0.879	0.408	0.0329	−0.604	0.412	0.1447
		INT−CTL	−0.432	0.522	0.4093	−0.081	0.521	0.8760

sessions, they are expected to be actively involved in the TEA Time family activities and TEA Garden community events. The main purpose of these activities is to promote parent–child communication and interactions.

Among the intervention components, there are two types of activities that specifically target children: five TEA Time homework assignments and two recommended routine family activities. The five homework assignments include: (1) My family kitchen, which tracks nutrition and exercise habits; (2) My family rainbow, which asks family members to identify colors that represent emotions of the entire family; (3) My family bag, which engages the entire family in the design and creation of a carrying bag that reflects important family values; (4) My family book, which requires children to fill out the information of a family book about their parents, including letters to their parents or grandparents; and (5) My dream painting, which allows children to showcase their creative artwork with the theme "my dream" at a community event. There are also two routine family activities: (1) Table topics, wherein 100 relevant topics are printed on index cards and placed in a decorative box on the dining table; children take the lead to take a card and start discussions of each topic among family members; and (2) Family album, where each family is provided a digital camera in order to record their daily life and the TEA Time activities, and then share the family album with others.

Participants in the control group received current standard care program provided by the local government,

including receiving educational material and attending classes on health education, personal hygiene and nutrition. Only PLH participated in these group activities, and no home-based or community-based activities provided in the control condition.

Measurement

For PLH and family members, demographic information such as age, gender, and education was collected. For the children, demographic data included gender and age. According to Kail's definition [31] and Chinese cultural context, children were divided into two age groups (6–12 and 13–18 years). The primary outcomes for children included self-esteem, perceived parental care, and problem behavior. Measures used for PLH and family members included depressive symptoms and family functioning.

Parental care was adapted from the Parental Bonding Instrument [32]. The original scale consists of 25 items on two separate dimensions (care and overprotection) based on the parental styles as perceived by the child. Considering the cultural context and relevance to our study, we included only the care dimension of the original instrument, which consists of 12 items that reflect parental warmth and interest. The sample questions are "Speak to me in a tone that is warm and friendly", "Doesn't help me as much as I would need". Parental care was the sum of the 12 items. Some items were

reverse-coded so that the final scores were in the direction that the higher score indicated a high level of perceived parental care (Cronbach's alpha = 0.66).

Self-esteem was assessed with the Rosenberg Self-Esteem Scale [33], which consists of 10 items assessing feelings of self-worth or self-acceptance. For each item, participants were asked how true each statement was for them on a four-point Likert scale ranging from "strongly agree" to "strongly disagree." Self-esteem was the sum of the 10 items. Some items were reverse-coded so that a higher score indicated a high level of self-esteem (Cronbach's alpha = 0.69).

Problem behavior was measured by counting the presence or absence of a list of behaviors that were related to (1) withdrawal (e.g., not getting along with other children, self-imposed solitude, refusal to talk, unhappiness, sadness or depression, and shyness), (2) aggression (e.g., often argues, disobedient at home, throw temper tantrums or have a hot temper, get in many fights, and often screams), and (3) delinquency (destroy things belonging to family or other children, hang around with children who get in trouble, lie or cheat, use obscene language, and disobedience at school). All 15 items were combined in this study, with a higher score indicating a high level of problem behavior (Cronbach's alpha = 0.70).

Depressive symptoms, one of the two parental measures for PLH and family members, was assessed by the short version of the Zung Self-Rating Depression Scale, which is a nine-item instrument adapted from the original 20-item questionnaire [34]. The PLH and family members were asked what they felt in each of nine situations; sample responses include "I feel downhearted and blue," "I get tired for no reason," and "I have trouble sleeping at night." Response categories were on a four-point Likert scale from 1 (a little of the time) to 4 (most of the time). The overall score was the sum of the individual items. A higher score on the scale indicates a higher level of depressive symptoms (Cronbach's alpha = 0.81).

Family Functioning was measured by an adapted version of the Family Functioning Scale [35, 36]. This 75-item instrument consists of 15 topics centered on family functioning, system maintenance, and personal growth. For the purpose of this study, we chose only three sub-scales (family cohesion, family conflict, and family sociability). A total of 15 statements were used, with each consisting of five items. For each item, participants were asked to rate how true each statement was for their family on a four-point Likert scale. A higher score indicated a better family functioning. Cronbach's alpha value for the overall scale was 0.82.

Statistical Analysis

Descriptive statistics and frequencies for children, PLH, family members, and family characteristics at baseline were summarized by group. Differences in these characteristics between intervention and control groups were tested using Chi square or Fisher's exact tests for categorical variables and t tests (or Wilcoxon rank tests) for continuous variables.

Intervention effects on children's outcomes were examined based on an intent-to-treat basis. Analyses were conducted for two objectives. First, for each of the two age groups of children, we were interested in assessing whether the changes in the children outcomes (self-esteem, parental care, and problem behaviors) were different between the intervention and control conditions at each follow-up assessment. Second, we were interested in investigating whether PLH and family members' measures were associated with their children's outcomes. To address these objectives, we used a single model approach (with interaction terms) to (1) examine the overall intervention effects on these outcome measures, (2) estimate the intervention effects for each age group of children, and (3) compare the intervention effects between two age groups. All these comparisons of interest can be done through the model contrasts. In addition, for each outcome measure, we also estimated variations between (σ_b^2) and within (σ_w^2) families using intraclass correlations, ICC $= \sigma_b^2 / (\sigma_b^2 + \sigma_w^2)$. Alternative to the single model approach, we could have used the stratified analysis approach (i.e., separate models for each age group), which would be simpler for making inferences. However, this approach did not allow us to address the above questions simultaneously and would have yielded a smaller sample size.

To address the first objective, we used a single, mixed-effects regression model to assess the intervention effect on the improvement of self-esteem, parental care, and problem behavior measures. Covariates included age group (6–12 and 13–18), intervention status (control vs. intervention), visit (baseline, 3-, or 6-month follow-up), three two-way interactions (age group-by-visit, age group-by-intervention, intervention-by-visit), and one three-way interaction (age group-by-intervention-by-visit). The model also included children-level random effects (η_i) to account for the correlation between repeated observations for each child. The regression model can be expressed as follows: $y_{ij} = \alpha_0 + \alpha_1 \times age\ group + \alpha_2 \times intervention + \alpha_3 \times visit + \alpha_4 \times age\ group \times intervention + \alpha_5 \times age\ group \times visit + \alpha_6 \times intervention \times visit + \alpha_7 \times age\ group \times intervention \times visit + \eta_i + \varepsilon_{ij}$, where y_{ij} is the child outcome of the ith child at the jth visit, and $\alpha_0, \ldots, \alpha_7$ are regression coefficients. We refer to this as an "unadjusted" model. To address the second objective, we added the PLH and family members' outcome measure to the "unadjusted" model as a time-varying covariate to investigate whether adults' outcome measure was associated with their children's outcome and whether the intervention effect on

children's outcome was influenced by PLH and family members' measure. We ran a separate model for each of the two adults' measures and repeated theses regressions for each of the children's outcome measures. Model fit statistics and Akaike information criterion (AIC) were also provided. All statistical analyses were carried out with the SAS System for Windows (SAS Institute Inc., Cary, NC, version 9.2).

Results

Demographic Characteristics at Baseline

Children, PLH, family members, and family characteristics are summarized in Table 1. Of the 79 families, 38 families were randomized to the intervention condition and 41 families to the control condition. Two age groups of children (6–12 and 13–18 years) were included in the study; 53 % of the children in the intervention group versus 32 % of the children in the control condition were in the younger age group (6–12 years). More than half of the children were male. At baseline, we observed comparable levels of self-esteem and problem behavior measures between the two intervention conditions. However, the average parental care for the control condition was higher than that for the intervention group ($P = 0.03$).

PLH in the intervention group were on average one year older than those in the control condition. Most of these families included male PLH and female family members. More than a half of PLH (61 vs. 51 % for the intervention vs. control, respectively) reported 1–5 years of education. However, about 39 % of the PLH in the control condition reported six or more years of education. About 44 % of the families had only one child, and less than 7 % of the families had three or more children. No significant differences in PLH, family members, and family characteristics between the two intervention conditions were observed.

Intervention Effects on Children's Outcome Measures

Table 2 presents the results for self-esteem, parental care, and problem behavior measures from the mixed-effects regression models. In these models, no significant interaction effects on the outcome measures were observed. Thus we estimated the overall intervention effect on each of these measures by averaging the intervention effects across age groups.

At the 3-month follow-up, we observed significant increases in the level of self-esteem for the intervention children aged 6–12 (change from baseline: 1.85 ± 0.92,

$P = 0.047$) and adolescents aged 13–18 (change: 2.38 ± 1.01, $P = 0.020$), whereas no improvement in self-esteem was observed for children in the control condition for both age groups. The adolescents (children in the older age group) in the intervention group showed more improvement than those in the control condition (difference: 2.31 ± 1.29), but the difference did not reach significance ($P = 0.076$). At the 6-month follow-up, the intervention children in the younger age group continuously improved in self-esteem (change: 2.40 ± 0.94, $P = 0.012$). However, no significant differences in improvement between the intervention and the control for both age groups were observed. The overall increase in the level of self-esteem at the 3- and 6-month follow-ups for the intervention children were higher than those in the control condition [changes: 1.70 (± 0.98, $P = 0.086$) vs. 1.76 (± 1.02, $P = 0.086$), respectively]. Self-esteem varied significantly across families, with 24 % of variance explained by family clustering (ICC = 0.24).

Similarly, we observed significant improvement in parental care for the intervention children aged 6–12 at the 3-month follow-up (change: 1.10 ± 0.37, $P = 0.004$) and the improvement remained at the 6-month follow-up (change: 1.18 ± 0.38, $P = 0.002$). At the 6-month follow-up, the intervention children in the younger group demonstrated a significantly greater improvement in parental care as compared to those in the control condition (difference: 1.42 ± 0.64, $P = 0.030$). Adolescents aged 13–18 in both the control and intervention conditions demonstrated significant increases in the level of parental care at 6 months [changes: 0.69 (± 0.32, $P = 0.033$) vs. 0.90 (± 0.41, $P = 0.031$), respectively]. Overall, the improvement in parental care for the intervention children across age groups was greater than that for the children in the control condition (difference: 0.81 ± 0.41, $P = 0.051$). The estimated ICC for this model was 0.37.

For children aged 6–12, a significant decrease in problem behavior was observed at both follow-ups for the control condition [reductions: 1.23 (± 0.46, $P = 0.008$) vs. 1.31 (± 0.52, $P = 0.013$), for 3- and 6-month follow-ups]. However, no differences in reductions between the intervention and control for this age group were observed at the follow-up assessments. For adolescents aged 13–18, the only group of children who demonstrated a significant reduction in problem behaviors at the 3-month follow-up was the intervention group (Reduction: 0.88 ± 0.41, $P = 0.033$). Overall, we observed no significant differences in reductions between the intervention and control conditions. However, the estimated ICC in this model was the highest among the three outcome measures (ICC = 0.64).

Table 3 Mixed-effects regression model on child outcome measures without and with parents' covariates

	Comparison	Change in outcome from baseline					
		3-month			6-month		
		Estimate	SE	P	Estimate	SE	P
Outcome: self-esteem							
M1: without parental covariates (AIC = 1,166)	Intervention−control	1.795	0.938	0.058	1.878	0.943	0.048
M2: with depressive symptoms (AIC = 1,156)	Intervention−control	1.777	0.991	0.075	1.980	0.987	0.047
PLH	0.017 (0.048), P = 0.72						
Family member	−0.020 (0.050), P = 0.68						
M3: with family functioning (AIC = 1,153)	Intervention−control	1.732	0.961	0.074	1.904	0.981	0.054
PLH	0.011 (0.053), P = 0.84						
Family member	0.082 (0.053), P = 0.13						
Outcome: parental care							
M1: without parental covariates (AIC = 793)	Intervention−control	0.647	0.387	0.097	0.620	0.389	0.114
M2: with depressive symptoms (AIC = 790)	Intervention−control	0.522	0.398	0.192	0.449	0.395	0.258
PLH	0.0004 (0.021), P = 0.98						
Family member	−0.025 (0.022), P = 0.22						
M3: with family functioning (AIC = 789)	Intervention−control	0.617	0.388	0.114	0.503	0.397	0.207
PLH	0.004 (0.022), P = 0.86						
Family ember	0.029 (0.023), P = 0.22						
Outcome: problem behavior							
M1: without parental covariates (AIC = 854)	Intervention−control	0.152	0.381	0.690	0.155	0.384	0.687
M2: with depressive symptoms (AIC = 851)	Intervention−control	0.044	0.403	0.912	0.085	0.397	0.831
PLH	0.011 (0.022), P = 0.63						
Family member	−0.036 (0.026), P = 0.17						
M3: with family functioning (AIC = 851)	Intervention−control	0.260	0.382	0.496	0.303	0.392	0.441
PLH	−0.035 (0.024), P = 0.14						
Family member	0.019 (0.025), P = 0.46						

PLH and family members' measures (depressive symptoms and family functioning) were included in the models (M2 and M3, respectively) as time-varying covariates. Estimated coefficient (SE) and P value are shown for time-varying parameters. None of these covariates were significant

Assessing PLH and Family Members' Influence on Children's Outcome Measures

As mentioned above, the age group-related interaction terms (age-by-visit, age-by-intervention, and age-by-intervention-by-visit) were not significant in those regression models. Thus, we removed the age group-related interaction terms from the main model, and formed the reduced model to investigate whether PLH and family members' measures influenced children's outcomes. Table 3 presents results from the unadjusted (reduced) model (M1) and the adjusted models with PLH and family members' depressive symptoms (M2) and family functioning (M3).

For the children's self-esteem measure, the overall intervention effects from the unadjusted model (M1) were slightly greater than those found with the main model, and the overall effect became significant at the 6-month follow-up (difference: 1.88 ± 0.94, $P = 0.048$). When the time-varying depressive symptoms reported by PLH and family members were included in the model (M2), the estimated intervention effects became slightly less at the 3-month follow-up but slightly greater at the 6-month follow-up. This may suggest that the intervention effects on self-esteem measure were slightly influenced by the depressive symptoms reported by PLH and family members, even though none of these covariates were significant. The model with family functioning reported by PLH and family members (M3) showed similar results. In light of children's perceived parental care, the overall intervention effect at the 3-month follow-up was similar between the "reduced" model (M1) and the main model. However, the overall intervention effect found from Model M1 at the 6-month follow-up was less than that from the main model (difference: 0.62 ± 0.39, $P = 0.114$). When depressive symptoms or family functioning reported by PLH and family members were included in the model (M2 or M3, respectively), the intervention effects became less than those found in the reduced model (M1). This suggests that the

time-varying covariates reported by adults might slightly influence the parental care reported by their children. However, these associations were not statistically significant. For both self-esteem and parental care measures, the model fit statistics (AIC) from the three models were very similar.

Discussion

With more and more children and adolescents affected by HIV, family-based intervention programs are urgently required. The inclusion of PLH, family members, and children in the outcome analyses of this study provides a unique opportunity to observe the impact of an intervention on various members within a family. In this study, we identified some intervention effects related to children's psychological measures accompanied by the improvement of the mental health of PLH and family members. Public health officials must consider the impact of HIV on children when evaluating the social costs of having a parent with HIV/AIDS. Adding another layer of complexity is the importance of the mental health and well-being of additional family members who may provide care or counseling to ill parents. This study provides evidence that positive effects for PLH, family members, and children can be achieved with a multilevel intervention designed and implemented to meet the needs of a targeted population. Our findings underscore the importance of empowering families impacted by HIV to confront the challenges as a whole rather than individually.

One interesting finding was that children in the younger age group showed more positive responses compared to the adolescent children. Several explanations for this finding may be considered. First, parents and other caregivers in the family may pay more attention to younger children. Second, PLH and family members might find it easier to involve younger children in the intervention activities rather than adolescent children. Third, the TEA Time activities designed for adult–children interactions seemed to be more appealing to younger children than adolescent children. Sherr [37] argues that challenges faced by children at different ages and developmental stages call for age-specific psychosocial interventions. Interventions focusing on younger children have the potential to have long-term impact, while adolescents may need interventions that focus on communication and vocational skills to support their transition into adulthood [38]. This finding can further inform intervention programs to be age- and developmental stage-specific in order to achieve more benefits.

It should be noted that the outcomes for families in the control condition also improved over time, raising the possibility that participation in the study itself might have had a positive effect on the families. Repeated assessments, such as interviews every 3 months and repeated questions about mental health, family functioning, and behavior, may spur self-reflection, even without the benefit of the intervention.

Several limitations must be noted. First, this is a randomized pilot study with a relatively small sample. Second, although measurements used in our study have been validated previously, they were prone to potential bias stemming from self-reports. Third, because of the study period of 6 months, we cannot determine whether the benefits from the intervention will be sustainable in the long-term. Despite these limitations, our findings indicate that the family system and interactions that involve all family members, including children, should be fertile ground for future study and intervention development. Beyond the need for better ways to mitigate the stress and depression experienced by PLH and their family members, there is an urgent need to intervene on behalf of children in HIV-affected families. Our study findings suggest that problem behavior was more difficult to change for adolescents than for younger children; therefore, it is important to identify and intervene as early as possible. Integrating a family perspective into future interventions requires special consideration for child-adequate and age-specific strategies.

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