HHS Public Access

Author manuscript

Prev Sci. Author manuscript; available in PMC 2024 November 01.

Published in final edited form as:

Prev Sci. 2023 November ; 24(8): 1558–1568. doi:10.1007/s11121-022-01370-8.

Long-term effects of the Family Check-Up on suicidality in childhood and adolescence: Integrative Data Analysis of three randomized trials

Arin M. Connell,
Case Western Reserve University

Samuel Seidman,
Case Western Reserve University

Thao Ha,
Arizona State University

Elizabeth Stormshak,
University of Oregon

Erika Westling,
Oregon Research Institute

Melvin Wilson,
University of Virginia

Daniel Shaw
University of Pittsburgh

Abstract

This study employed integrative data analysis techniques to examine the long-term effects of the Family Check-Up (FCU) on changes in youth suicide risk using three randomized prevention trials, including one trial initiated in early childhood and two initiated in early adolescence. Data were harmonized across studies using Moderated Nonlinear Factor Analysis, and intervention effects were tested using an Autoregressive Latent Trajectory model examining changes in suicide-risk across long-term follow-up. Across trials, significant long-term effects of the FCU on reductions in suicide-risk were observed, although differences between intervention and control group trajectories declined over time. No moderation of intervention effects was observed by youth gender or race/ethnicity, or across samples. While results offer further support for the benefits of the FCU for suicide-risk reduction, they also suggest that such effects may wane over time, underscoring the need for continued development of the FCU to enhance longer-term durability of effects on suicide-related behaviors.

Address correspondence regarding this paper to Arin M. Connell (arin.connell@case.edu).

Conflicts of interest/Competing interests. The authors declare no conflicts of interest.

Compliance with Ethical Standards.

Ethics approval. Approved by Case Western Reserve University IRB, STUDY20191414.

Consent to participate. Not applicable (secondary data analysis).

Keywords

Suicide; Prevention; Family Check-Up; Parenting; Childhood; Adolescence

The identification of effective suicide prevention programs for children and adolescents represents a critical public health goal. Between 10 – 20% of youth report significant suicidal ideation across adolescence, and suicide is now the second leading cause of death between the ages of 15 to 25 (see Turecki and Brent, 2016). Moreover, the age-adjusted suicide rate in the United States increased 24% (from 10.5 to 13.0 per 100,000 people) over the last 20 years, with the largest increases in suicide rates observed for females aged 10–14 (Curtin et al., 2016), and in African American children aged 5–11 (Bridge et al., 2015). Such increases highlight the need for improved understanding of suicide risk development across childhood and adolescence (e.g. Janiri et al., 2020), and underscore the need for effective early prevention.

Self-injurious thoughts and behaviors (SITBs) are related to a complex array of risk factors, including genetic and neurobiological, cognitive, and social processes (e.g., Cha et al., 2018). In particular, family-level factors, including conflict, parental criticism and low-support, and parental psychopathology, appear central to the development of SITBs across childhood and adolescence (see Frey & Cerel, 2015; Janiri et al., 2020). Of note, these familial risk factors are related to a broad array of emotional and behavior problems in youth beyond SITBs (Rose et al., 2018), and they are commonly targeted in family-focused prevention and intervention programs.

Indeed, most effective intervention programs for suicidal adolescents incorporate a focus on improved parent and family functioning. A recent review by Glenn and colleagues (2019) found that five of the six best-supported interventions for adolescent suicide incorporated parent and family functioning as a core component. Common targets include parent and family psychoeducation regarding suicide, support for emotion regulation skills, and training in family communication and problem-solving skills. Further, although few studies have tested mediation, a randomized trial of the Resourceful Adolescent Parent Program (RAP-P; Pineda & Dadds, 2013), a parent-focused intervention emphasizing supportive parenting strategies and conflict-reduction skills, found that intervention effects on adolescent suicidal behavior over a 6-month follow-up were mediated by improvements in family functioning.

Emerging evidence also indicates that family-focused prevention programs may yield long-term reductions in suicide-risk, even when SITBs were not directly targeted. For instance, Familias Unidas, a family-based prevention program designed to reduce behavior problems in Latinx youth, was found to reduce suicide attempts by 30-month follow-up in large sample of Latinx families recruited when youth were in 8th grade (Vidot et al., 2016). Comparable effects on reduced SITBs in youth have been reported in several other prevention programs with significant family-focused components targeting conduct problems (e.g. Kerr et al., 2014) and parental bereavement (Sandler et al., 2016), suggesting that prevention programs targeting common family risk processes may lead to reductions in SITBs across early development.

Family Check-Up program

The current study examines effects of the Family Check-Up (FCU) prevention program on suicide-risk across three randomized controlled trials, two of which were initiated in early adolescence (age 11–12), and one of which was initiated in early childhood (age 2). The FCU was originally designed to prevent the development of conduct problems and substance use by enhancing positive parental support and parent management practices and fostering effective family problem-solving and communication skills. At the core of the FCU program is a comprehensive three-session assessment and feedback process, based upon Motivational Interviewing principles. This process culminates in a family feedback session designed to support positive parenting practices and motivate parents to modify their behavior on behalf of their child's welfare. Parents then have the option of engaging in follow-up treatment sessions around effective family management, relationship practices, and addressing other issues that compromise parenting quality (e.g. parent self-care, neighborhood safety). Subsequent treatment sessions involve family-based intervention tailored to the individual goals of the family, including positive parenting practices (e.g., positive reinforcement, family-problem-solving), relational concerns (e.g., co-parenting), and contextual issues (e.g., school-communication).

Separate analyses from the individual trials have documented the effects of the FCU on a broad range of child and family outcomes, including those that were originally targeted as well as additional outcomes that were not the primary focus. In trials initiated in early adolescence, the FCU led to improvements in conduct problems and substance use development (Veronneau et al., 2016), as well as a broader range of youth outcomes, such as sexual-risk behavior and academic performance (Caruthers et al., 2014; Stormshak et al., 2009). The adolescent version of the FCU also resulted in improvements in parent monitoring and communication, and reductions in family conflict in adolescence (e.g., Stormshak, et al., 2011; Fosco et al., 2016). Similarly, a version of the FCU adapted for early childhood led to improvements in a range of child and parental outcomes, including emotional and behavior problems from early childhood through adolescence (e.g., Dishion et al., 2008, 2014), in part mediated by improvements in positive parenting (Dishion et al., 2008), and maternal depression (Shaw et al., 2009).

We have also observed effects on youth internalizing problems in both adolescent and early-childhood FCU trials (e.g. Connell et al., 2008, 2018; Shaw et al., 2009). Although these were not original targets of the FCU program, there is considerable overlap between family-risk processes associated with conduct problems and depression / suicidality, so programs targeting such family-risk mechanisms may have a broad array of collateral benefits for children and adolescence. Of note, analyses of individual trials have found effects of the FCU on suicide-related outcomes. In an adolescent trial, Complier Average Causal Effect analyses yielded large intervention effects on a cumulative suicide-risk score (aggregating thoughts of death, ideation, and attempts) in late adolescence and early adulthood, specifically among youth whose families engaged with the FCU (Connell, McKillop, & Dishion, 2016). In a trial initiated in early childhood, analyses comparing suicide-related behaviors in the intervention versus control conditions examined summary scores reflecting chronicity and severity of suicide-related behavior across parent, teacher,

and youth-reports from ages 7.5 to 14 years. Although main effects of the FCU on suicide-related outcomes were generally observed at the level of statistical-trend, mediation analyses found significant indirect effects of the FCU on reductions in suicide risk by age 14 via improvements in youth inhibitory control across early childhood.

One challenge in individual trial analyses of FCU effects on suicidality, however, is the limited measurement of suicide-related outcomes, constraining our understanding of the potential benefits of the FCU across developmental periods. In particular, changes in measurement approaches in the individual trials have limited the scope of longitudinal analyses. For instance, in the Early Steps Multisite study, different measures were administered in early childhood versus early adolescence, and data from different informants were available in different developmental spans (e.g. child reports of SITBs were not collected until early adolescence). Individual trial analyses also suffer from statistical power challenges associated with the examination of lower base-rate outcomes such as SITBs. These measurement and power challenges may be addressed by modern Integrative Data Analysis (IDA) techniques.

Current Study

The goal of the current work was to employ IDA techniques to harmonize depression data across three trials of the FCU, to enhance statistical power to examine prevention effects on suicidality across late middle childhood and adolescence. Specifically, we employed Moderated Nonlinear Factor Analysis (MNLFA; Bauer & Hussong, 2009) to facilitate item-level analyses across trials, despite the use of different measures and items across studies. MNLFA provides a robust means to examine Differential Item Functioning (DIF) across subgroups of participants (e.g., by gender), and to create scale scores based on all available items while accounting for DIF. Therefore, MNLFA enables the estimation of a common latent variable across samples that incorporates all of the available information across measures, even if there are differences in available measures over time and across studies. In the current analyses, the latent variable estimate is a continuous suicide-risk score that reflects youths' underlying severity of suicidal thoughts and behaviors. It captures the constellation of youth, parent, and teacher reports of thoughts of death, suicidal ideation, self-harm, and suicide attempts that were included as categorical observed variables in the latent variable estimation process, as these are all signs that the youth is at elevated risk for completed suicide.

In the current analyses, we sought to examine the long-term effects of the FCU on suicide-risk across three randomized trials of the FCU. These trials cover a broad developmental span with one trial beginning at age 2 and the other two trials beginning at approximately age 11. Although there are differences in ages at baseline, there are overlapping ages across all three trials in early to mid-adolescence. Further, significant FCU effects on suicidality have been observed in trials initiated in both early childhood and early adolescence (Connell et al., 2016, 2019), supporting the possibility of harmonizing data across these trials to examine pooled prevention effects. However, we also examined possible differential treatment effects across trials to further examine the feasibility of aggregating data across these samples.

The trials included long-term follow-up assessments, with the current analyses examining the durability of FCU effects on suicide-risk over more than a decade. We also examined differences in outcomes in relation to youth gender and race/ethnicity. Surprisingly few suicide-prevention studies have examined such moderators of program effects (see Musci et al., 2018). However, the identification of factors associated with variability in response to suicide prevention programming is an important public health goal, which may highlight opportunities for further program development to better meet the needs of different populations of youth. Based on the sparsity of evidence regarding possible gender or race/ethnicity differences in prevention effects on suicide-related outcomes, these analyses were considered exploratory.

Methods

Samples

Early Steps.—This prevention trial includes 731 mother–child dyads, recruited between 2002 and 2003 from Pittsburgh, Pennsylvania, Eugene, Oregon, and Charlottesville, Virginia (for complete details see Dishion et al., 2008). The sample included diverse racial/ethnic representation (54.4% White, 28.2% African American, 10.7% Latinx, and 6.7% multiracial or other), and 49.5% of youth were female. Families with children between the ages of 2 years 0 months and 2 years 11 months were recruited from Women, Infants, and Children Nutritional Supplement (WIC) centers. Following screening, high-risk status on at least two of three risk domains was required for study inclusion: (a) child behavior (conduct problems, high-conflict relationships with adults), (b) family problems (maternal depression, daily parenting challenges, substance use problems, teen parent status), or (c) socio-demographic risk (low educational achievement and low family income using WIC criteria). Families completed assessments at 10 study waves, from child ages 2 through 16 years. Retention was above 80% for most assessments, including at ages 14 and 16 (82%), with 73% retention at the lowest point (age 7.5).

At baseline, families were individually randomized to intervention (50.2%) or control conditions (49.8%). Control families completed assessments but were not offered intervention services. Intervention families were offered the FCU and follow-up services as warranted, on eight occasions from age 2 to 10.5 years. Of the 367 families randomized to the intervention condition, 343 (93.5%) took part in the FCU (an initial interview, assessment and feedback sequence) at least once by age 10.5 years. The percentage of families receiving the FCU at each wave ranged from 66% (at age 5) to 76% (age 2), and most of these families elected to receive follow-up sessions on parenting, child development, and behavior management. The percentage of FCU-completing families opting for further sessions ranged from 65% (age 7.5) to 74% (age 4), with the average number of sessions ranging from 2.3 (age 10.5) to 3.5 sessions (age 5).

Project Alliance 1 (PAL1).—This trial includes 998 adolescents and their families, recruited in 6th grade from three middle schools within a metropolitan community in the northwestern United States. Parents of all 6th grade students were invited, and 90% consented to participate. In the sample, 50.6% of youth were female, with diverse racial/

ethnic representation (49.2% White, 29.2% African American, 6.8% Latinx, and 14.8% multiracial/other). In the spring of 6th grade, youth were randomly assigned at the individual level to either control (498 youth) or intervention classrooms (500 youth). Families completed assessments at 10 study waves, from youth ages 11 to 28. Retention was above 80% for most timepoints, with 75.6% retention at the last assessment. Control participants completed assessments but were not offered intervention services.

In the intervention condition, 115 families (23%) received the FCU in grades 7–9, and 88 families (17.6%) received further intervention services after the FCU. FCUs also were offered in grades 10–11, and 170 families (34%) received the FCU at that time, 109 of whom had not received it previously. Therefore, 224 families (45%) received the FCU across the study.

Project Alliance 2 (PAL2).—This trial includes 593 families recruited in 6th grade from three urban middle schools in the northwestern United States. Parents of all 6th grade students were approached, and 76% consented to participate. In the sample, 48.5% of youth were female, with diverse racial/ethnic representation (36% White, 15.2% African American, 18% Latinx, and 30.8% multiracial or other). Families were randomly assigned to "school as usual" (*n*=207; 35%) or to the intervention condition (*n* = 386; 65%), using unbalanced design to increase the power to examine patterns of intervention engagement. Families completed assessments at seven study waves, from youth ages 11 to 23. Retention was above 80% for most assessment points, with 78% of participants completing at least one early-adult assessment.

Within the intervention condition, 42% (*n* = 163) of families received the FCU between grades 7–9, 80% of whom received follow-up intervention services (average intervention duration = 5.62 hours). The FCU was offered to families again at age 20, and 34.7% (*n* = 134) of intervention families received the FCU (average intervention time = 1.92 hours).

Intervention Details

The FCU includes a 3 session FCU-Assessment, based on MI principles, and age-appropriate follow-up services based upon the Everyday Parenting Curriculum (EPC; Dishion et al., 2012).

Early Steps.—Potential intervention targets and topics were adapted to be appropriate for early childhood, including topics on parenting practices, family management concerns (e.g., co-parenting), and contextual issues (e.g., child care, partner relationship, housing, parent self-care).

PAL1 and PAL2.—PAL1 and PAL2 were both school-based prevention trials employing a multilevel prevention framework. The universal intervention focused on supporting positive parenting practices and engaging parents of high-risk youth for the selected intervention, and included the establishment of a Family Resource Center (FRC) in each school, offering brief parent consultations, feedback to parents on their student's behavior at school, and access to videotapes and books. The selected intervention was the three-session FCU assessment. The FCU feedback leads to a collaborative decision with parents on indicated services consistent

with their goals, including a parent group intervention and individually based behavior family therapy, grounded in the EPC (Dishion et al., 2012), and focused on building positive parenting skills (e.g., positive reinforcement, limit-setting, problem-solving, and communication skills).

Measures

Supplemental Table 1 lists measures administered in each sample at each assessment point.

PAL1—A stratified assessment approach was used at the age 11, 12, and 13 assessments, with the Child Behavior Checklist for Ages 6–18 (CBCL; Achenbach, 1991) and Child Depression Inventory (CDI; Kovacs, 1992) only collected for an elevated-risk subset of youth. Risk-stratification was based upon teacher-reports of behaviors related to the risk for conduct problems (see Connell & Dishion, 2008). This elevated-risk subsample was identified using a brief teacher-report measure that assessed behavioral and emotional problems (but did not assess suicide-related behaviors; see Connell & Dishion, 2008). Students identified by this brief teacher-report screening measure as exhibiting risk-behaviors were asked to complete additional survey measures, including those assessing depression and suicide-related behaviors.

At ages 11 to 13 (elevated-risk only), and 18 (entire sample), youth completed the CBCL-ages 6–18 (Achenbach, 1991). Parents also completed the CBCL at youth ages 11 to 13 (elevated risk only), 18 and 23 (entire sample), while teachers completed the CBCL at youth ages 11 to 13 (elevated risk only). The CBCL includes two items reflecting suicidal ideation (e.g., youth-report: “I think about killing myself”) and self-harm/suicide attempts (e.g., youth-report: “I deliberately try to hurt or kill myself”) in the prior six months. Teacher-reports of self-harm/suicide attempts were not included in harmonization analyses due to sparse endorsement (3 endorsements across assessment waves), although teacher-reported ideation was included.

Youth completed the CDI (Kovacs, 1992) at ages 11, 12, and 13 (elevated-risk only), which includes one item assessing suicidal ideation in the past two-weeks. At age 11, 12, 13 (elevated-risk), and 16 (full sample), youth completed a self-report health measure with one item reflecting past-year suicide attempts. Youth completed the Life Events Coping Inventory (LECI; Dise-Lewis, 1988) at ages 11, 12, 13 (elevated-risk), 16, 18, 22, and 23 (full sample), with two items reflecting ideation and self-harm in response to stress. At ages 16, 22, and 23, youth completed the Brief Symptom Inventory (BSI; Derogatis & Spencer, 1982), assessing past-week ideation.

Participants completed the Composite International Diagnostic Interview (CIDI; World Health Organization, 1997), administered by trained staff blind to intervention status, at ages 18 and 28 years. Analyses included suicide-related items from the depression module.

PAL2—Youth completed the CDI (Kovacs, 1992) at ages 11, 12, and 13, as part of the FCU assessment. At ages 20, 21, and 22, parents and youth completed the CBCL (Achenbach, 1991), with items measuring ideation and self-harm/suicide attempts.

Early Steps—Parents and teachers completed the CBCL-ages 6 – 18 (CBCL; Achenbach, 1991) during the age 7.5, 8.5, 9.5, 10.5, 14, and 16-year assessments. Due to IRB concerns, only the suicide ideation item was administered in Early Steps. Parents and children independently completed the computerized Diagnostic Interview Schedule for Children IV (DISC-IV; Shaffer et al., 2000) at age 10.5. Analyses included suicide-related items from the depression module.

Analytic plan

Data Harmonization—Data harmonization analyses employed MNLFA (see Hussong, Curran, & Bauer, 2013), which facilitates item-level analyses across datasets when items from different measures have been used across trials. MNLFA permits the estimation of a final latent-variable reflecting the construct of interest, adjusting for DIF when observed. Analyses included six indicators, aggregated across available measures by reporter at each study wave, including three youth-report indicators (Thoughts of Death, Suicidal Ideation, and Self-harm/Suicide Attempt), two parent-report indicators (Suicidal Ideation and Self-harm/Suicide Attempt; parents did not report on children's thoughts of death across studies), and one teacher-report indicator (Suicidal Ideation). All indicators were recoded into dichotomous scores (0 = not endorsed, 1 = endorsed).

We employed the R-based aMNLFA package (Gottfredson et al., 2019), with MNLFA analyses conducted in Mplus 8.5 (Muthen & Muthen, 2020). Following Gottfredson and colleagues (2019), a single time-point of data for each participant was randomly selected for a calibration sample to establish measurement properties. Using the calibration sample, an iterative series of analyses examined covariates effects on factor means, variances, and item intercepts/factor loadings to obtain item parameter estimates adjusting for DIF. Harmonization analyses included the following covariates: 1) Youth gender (−1 = male, 1 = female), 2) ethnic minority status (−1 = European American, 1 = racial/ethnic minority), 3) age at assessment, 4) Years Post Baseline, 5) intervention-assignment (−1 = Control condition, 1 = Intervention condition), and 6) study (with two orthogonal contrasts, comparing Early Steps with PAL1 and PAL2, and PAL1 with PAL2). We also tested 2-way and 3-way interactions involving Study × Age × Treatment, and Study × YPB × Treatment in separate analyses. When 3-way interactions were not significant, we tested all two-way interactions. When these were not significant, we tested a simpler main-effects-only model, presented in the results section.

First, separate analyses examined covariate effects on overall mean and variance in suicide risk, as well as in item factor-loadings (reflecting the extent to which individual items reflected risk severity) and item intercepts (reflecting the likelihood of item-endorsement across covariate levels for individuals at the same level of risk severity). Second, results from these analyses were included in a full model, simultaneously testing invariance across these model parameters for all covariates with significant effects in the initial analyses. Third, to protect against type-I errors, a Benjamini-Hochberg (1995) correction was applied to results from the second-stage analysis to generate a final scoring model that included significant effects that survived correction. Finally, MNLFA estimates were fixed to the parameter estimates from this final model, to generate a scoring model. This final scoring model was

then used to generate suicide risk estimates using the full longitudinal data set, which were used in subsequent analyses. The latent suicide-risk variable was scaled to have mean = 0 and variance = 1 in all MNLFA models.

Longitudinal models—Estimates of suicide risk generated from MNLFA were analyzed using an Autoregressive Latent Trajectory Model (ALT; Bollen & Curran, 2004). Growth models used "Years Post-Baseline" as the time-factor, with a score of "0" reflecting the pre-treatment baseline. The baseline assessment was not included in the estimation of the latent intercept or slope parameters but was allowed to predict subsequent suicidality. The autoregressive paths captured time-specific variability around the underlying latent trajectory. Intervention assignment was not allowed to predict the baseline time-point but was allowed to predict latent intercept and slope parameters. All other covariates were allowed to predict baseline, intercept and slope parameters. Post-hoc tests of differential intervention effects by gender, race/ethnicity, or study-membership employed multiplicative interaction terms between intervention assignment and gender, ethnicity, or the two study-contrasts (ES vs PAL1/2, and PAL1 vs PAL2). Analyses employed Full Information Maximum Likelihood (FIML; Rubin & Little, 2002) estimation to accommodate missing data. Acceptable model-fit is indicated by non-significant Chi-square value, CFI and TLI values above .90, and RMSEA values less than .08 (Hu & Bentler, 1999).

Results

Descriptive Statistics

The aggregated sample included data from 2322 families, although the number of parents and youth providing suicide-related data at each study wave is shown in Table 1. The combined sample included 49.7% female youth, and 47.5% were White, 25.4% were African American, 10.9% were Latinx, and 16.3% were multiracial or other race/ethnicity. Frequencies of endorsement for suicide-related items are shown in Supplemental Table 2.

Data Harmonization

Preliminary analyses examining 2-way and 3-way interactions between Age, Study, and Treatment, or between YPB, Study, and Treatment, yielded no significant 2- or 3-way interaction effects for DIF in latent variable means, variance, or item-intercepts/factor loadings. These interactions were removed, and the final series of analyses included only main effects of all covariates (Age, YPB, Treatment, Gender, Race/Ethnicity, and Study contrasts), although no significant main effects for DIF were observed, either. Factor loadings and item intercepts from the final iteration of MNLFA models are shown in Supplemental Table 3, along with estimates of covariate effects on the latent variable mean, although none were significant. Although teacher-reports of suicidal ideation did not significantly load on the latent variable, they were retained in the final model to enhance data coverage across samples. Estimates of suicide-risk variables from MNLFA results over studies and timepoints are shown in Supplemental Table 4.

Latent growth model

Preliminary analyses yielded poor model-fit and negative residual variance estimates for the final two timepoints (14- and 17-years post baseline). Of note, these time-points each included data from only one sample (ES and PAL1, respectively), and data from only one informant. When these time-points were removed from the analysis, the final ALT model provided acceptable model fit ($\chi 2 = 229.03$, df = 87, p < .05, CFI = .93, TLI = .91, RMSEA = .03). The latent intercept (estimate = .10, SE = .03) and linear slope (estimate = −.03, SE = .01) parameters were significant, as were the residual variances for both parameters (intercept variance = .02, SE = .003; Slope variance = .001, SE = .00). Autoregressive parameters were positive, with unstandardized estimates ranging from .19 to .60 (all *p*'s < .001).

Random assignment to intervention was significantly related to both the intercept (estimate = −.07, SE = .01, p < .001) and slope parameters (estimate = .009, SE = .002, p < .001). These intervention effects represent small to medium effects (Intercept: Cohen's d = −.47; Slope: Cohen's d = .33). The intervention effect, depicted in Figure 1, shows that random assignment to the FCU condition predicted stronger declines in suicide-risk over time. However, these intervention effects also waned over time, such that intervention and control conditions showed similar levels of suicide-risk by 10 years after the baseline assessment. To probe the time-course of intervention effects, a series of post-hoc tests were conducted by re-specifying the ALT model to locate the latent intercept at different time-points, providing a test of time-specific intervention effects. The intervention effect was only significant at from 1 to 7 years post-baseline (intervention effect estimates: 2 YPB (estimate = −.06, SE = .01, p < .001), 3 YPB (estimate = −.05, SE = .01, p < .001), 5 YPB (estimate = −.04, SE = .01, p < .001), 6 YPB (estimate = −.03, SE = .01, p < .01), 7 YPB (estimate = −.02, SE = .01, p < .05).

With respect to study contrasts, the Early Steps sample had a significantly lower intercept relative to the combined adolescent samples (estimate = −.04, SE = .01, $p < .01$), and a more negative slope (estimate = −.004, SE = .002, $p < .05$), both representing small differences (Cohen's d = −.23 and = −.16). Additionally, the intercept for PAL2 was more negative (estimate = −.07, SE = .02), a small to moderate effect (Cohen's d = .49). Female gender was significantly associated with higher baseline suicide-risk (estimate = .12, SE = .06, $p = .02$), a more positive intercept (estimate = .10, SE = .01, $p < .001$), and a more negative linear slope (estimate = −.005, SE = .002, $p = .02$). Racial/ethnic minority status predicted lower baseline suicide-risk (estimate = −.19, SE = .06, $p < .001$), and a more negative intercept (estimate = −.05, SE = .01, $p < .001$).

Moderation analyses

Moderation by youth gender and race/ethnicity was examined in separate follow-up analyses. For gender, interaction effects for intercept (estimate = .01, SE = .02, $p = .65$) and slope (estimate = .00, SE = .003, $p = .95$) parameters were not significant. Similarly, for race/ethnicity, interaction effects for intercept (estimate = −.03, SE = .02, $p = .22$) and slope (estimate = .001, SE = .003, $p = .85$) parameters were not significant.

Finally, two interaction effects were tested, comparing intervention effects in Early Steps compared to the adolescent samples, and comparing intervention effects in PAL1 versus PAL2, with interaction effects allowed to predict intercept and slope parameters. Comparisons of intervention effects in Early Steps versus adolescent samples on intercept (estimate = −.02, SE = .02, p = .37) and slope (estimate = .002, SE = .002, p = .43) parameters were not significant. Similarly, for the comparison of PAL1 and PAL2, intercept (estimate = −.04, SE = .05, p = .48) and slope (estimate = .003, SE = .007, p = .71) effects were not significant.

Discussion

The present findings demonstrate the long-term effects of the FCU prevention program on SITBs in childhood and adolescence across three randomized trials. Although we have previously documented FCU effects on suicide-related outcomes in two of these trials (Connell et al., 2016; 2019), research using individual trials is challenging due to the relatively low base-rates of SITBs, and differences in available assessments over time. The use of integrative data analytic techniques such as MNLFA provides a powerful opportunity to address these measurement issues by enabling the estimation of a common latent variable across samples over time despite differences in available measures, thereby facilitating the examination of long-term effects of the FCU on suicide-related outcomes across trials.

Significant prevention effects on SITBs were observed using harmonized data across trials, and these effects were sustained over 7 years following study initiation. In particular, we observed a small to moderate effect of the intervention on the intercept of the SITB trajectory (Cohen's d = −.47), reflecting a change of nearly half a standard deviation in the underlying suicide-risk scores for youth in the intervention versus control condition. The magnitude of the intervention effect on the intercept compares favorably to typical suicide prevention effects in this age-range. For instance, a meta-analysis of school-based prevention programs for from early elementary school through college-age showed small effects on suicidal ideation or attempts at short-term follow-up (equivalent to Cohen's d = .17; Brann et al., 2021), although larger effects have been reported in meta-analyses of suicide prevention programs in other settings and with broader age-ranges (e.g. Cohen's d = .41 for post-treatment ideation; Robinson et al., 2018).

However, the effects of the FCU declined over time, becoming non-significant by 9-years following the initiation of the trials. Of note, families in each prevention trial were offered the FCU at multiple occasions over time. In Early Steps, families were offered the FCU through child age 10.5 years. Similarly, in PAL1, families were offered the FCU through high school (grades 10–11), while PAL2 families were offered the FCU throughout middle-school, with a subsequent offering in early adulthood (approximately age 20 years). The pattern of results suggests that FCU effects on SITBs may benefit from ongoing availability of services. In light of the relatively brief but targeted nature of the FCU intervention, offering "booster-sessions" over time may represent a cost-effective approach to sustaining prevention effects on SITBs.

Of note, FCU effects on SITB trajectories did not differ by gender or race/ethnicity, or across the three samples. Little attention has been paid to the identification of factors that moderate prevention effects on suicide-related outcomes in youth (e.g., Musci et al., 2018), and the results of the few available studies have been inconsistent. Our results suggest that the FCU effects on SITBs is relatively consistent across gender and racial/ethnic groups. It will be important for future work to examine factors such as co-occurring conduct problems or substance use, or the intensity of family-level risk factors (such as the level of family conflict) that may be associated with variability in intervention effects. Such work may also point to future refinements of the FCU program to better meet the needs of different groups of families.

Although moderation effects were not observed, there were several covariate effects on suicide-risk trajectories that merit discussion. First, gender differences in suicide-risk trajectories were observed, as girls generally showed higher levels of risk, although gender differences waned over time. The literature on gender differences in SITBs is complex, although studies of adolescents have found greater prevalence of SITBs in females across earlier adolescence, with gender differences in diminishing by later adolescence (Lewinsohn et al., 2001). Second, racial and ethnic minority youth generally exhibited lower initial levels of risk compared to non-minority youth, although rates of change did not differ across groups. Such differences are consistent with trends observed in adolescence and early adulthood, although recent research has highlighted growing suicide-risk among black youth across childhood (e.g. Ramchand et al., 2021). Despite evidence of such gender and racial/ethnic differences in SITB rates in these trials, the FCU appeared to offer consistent benefits across gender and racial/ethnic groups.

Differences in trajectories across studies were also found. First, youth in the Early Steps sample exhibited lower levels of SITBs relative to youth in the two adolescent trials, differences that were small in magnitude, and likely driven by age as the prevalence of SITBs is lower in childhood (Janiri et al., 2020). Second, youth in the PAL2 sample exhibited lower initial levels of SITBs than youth in PAL1. This study difference may be attributable to differences in methods, as in the first three waves of PAL1, a stratified assessment approach was used, with suicide-related measures only administered to youth at elevated risk for conduct problems, as assessed by teacher report. Given that conduct problems are associated with elevated suicide-risk in this age-range (e.g. Linker et al., 2012), this assessment approach may explain differences in SITB trajectories across these two trials. Despite differences in overall levels of risk, it is worth emphasizing that no significant differences in intervention effects were observed across studies, either in harmonization analyses or in the final ALT model.

Summary and Future Directions

These results advance our understanding of the effects of the FCU prevention program on SITBs across childhood and adolescence. Prior trial-level analyses were not able to examine trajectories of SITBs given changes in available assessments over time, and so the current results provide a more detailed examination of the durability of FCU effects on suicidality than previously available. It is notable that these effects were achieved

by a program targeting general family-risk factors to prevent youth behavior problems and substance use. Family relationships are central settings for social and emotional development, and common family-level risk factors are associated with a broad array of problematic outcomes for children and adolescents. Programs like the FCU that target such family-risk factors may promote a broad range of benefits for youth beyond the original prevention targets, including reductions in suicide-risk. These results are consistent with perspective that most effective interventions for reducing suicide-risk include a core focus on improving parenting and family functioning (Glenn et al., 2019). The current results are also consistent with the emerging literature on "cross-over" effects of family-focused prevention programs on reducing suicide-risk across early development (Brent, 2016). Collectively, such results highlight that prevention and intervention programs that emphasize the development of supportive and proactive parenting strategies, the cultivation of effective family communication and problem-solving, and the establishment of healthy family routines are likely to have broad effects on a range of youth outcomes including suicide-risk.

As with any study, there are several limitations that point to future research directions. First, these trials covered a broad developmental span, with one beginning in early childhood and two in early adolescence. There may be developmental differences in risk and protective factors for SITBs in childhood versus adolescence (see Ayer et al., 2020). Future work examining whether different prevention targets are important in childhood versus adolescence is warranted. Second, the current analyses focused on a broad "suicide-risk" variable derived from harmonization analyses that incorporated a range of SITBs across youth, parent, and teacher reports. While this approach allowed us to conduct long-term longitudinal analyses across trials in the context of diverse measurement approaches and sometimes sparse data associated with lower base-rate outcomes, we were not able to examine specific effects on suicidal ideation versus attempts, or on youth- versus parent-reported outcomes. Third, future work is needed to examine mechanisms of intervention effects on SITBs. We suspect that prevention effects on suicide-risk may be mediated by improvements in parental use of positive, proactive parenting strategies, reductions in family conflict, and improvements in youth self-regulatory ability (e.g. Connell et al., 2019). Fourth, suicide-related behaviors occur at a relatively low base-rate in youth, particularly more extreme behaviors such as suicide attempts. A growing methodological literature suggests that IRT modeling of low base-rate phenomena using techniques that assume normal latent variable distributions, such as maximum likelihood estimation, may yield biased estimates of IRT parameters (e.g. Wall et al., 2015). Although newer developments such as IRT mixture modeling provide techniques to estimate IRT models with low base-rate behaviors, their use for data synthesis purposes with complex longitudinal designs has not been well-developed, and further work in this area is needed. Finally, future work adapting the FCU program to directly address suicide-related outcomes in high-risk youth (e.g., those displaying early symptom suicidality) may be warranted, and may yield stronger, more durable benefits for youth.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Funding.

This research was supported by grants from NIMH (MH122213 to Connell, Shaw, Wilson, Stormshak, Westling, & Ha), NIDA (DA25630 and DA26222 to Shaw, Dishion, and Wilson; DA07031 to Ha; and DA018374 to Stormshak), NIAAA (AA022071 to Ha), and NICHD (HD075150 to Stormshak).

References

Achenbach TM (1991). Manual for the Child Behavior Checklist/4–18 and 1991 profile. University of Vermont, Department of Psychiatry.

Ayer L, Colpe L, Pearson J, Rooney M, & Murphy E (2020). Advancing research in child suicide: a call to action. Journal of the American Academy of Child and Adolescent Psychiatry, 59, 1028 – 1035. [PubMed: 32145297]

Bauer D, & Hussong A (2009). Psychometric approaches for developing commensurate measures across independent studies. Psychological methods, 14, 101 – 125. [PubMed: 19485624]

Benjamini Y, & Hochberg Y (1995). Controlling the false discovery rate: a practical and powerful approach to multiple testing. Journal of the Royal statistical society, 57, 289–300.

Bollen KA, & Curran PJ (2004). Autoregressive latent trajectory (ALT) models a synthesis of two traditions. Sociological Methods & Research, 32, 336–383.

Brann K, Baker D, Smith-Millman M, Watt S, & DiOrio C (2021). A meta-analysis of suicide prevention programs for school-aged youth. Children and Youth Services Review, 121, 105826.

Brent D (2016). Prevention programs to augment family and child resilience can have lasting effects on suicidal risk. Suicide and Life-Threatening Behavior, 46, S39–S47. [PubMed: 27094110]

Bridge J, Asti L, Horowitz L, Greenhouse J, Fontanella C, Sheftall A, Kelleher K, & Campo J (2015). Suicide trends among elementary school-aged children in the United States from 1993 to 2012. JAMA Pediatrics, 169, 673–677. [PubMed: 25984947]

Caruthers A, Van Ryzin M, & Dishion T (2014). Preventing high-risk sexual behavior in early adulthood with family interventions in adolescence: Outcomes and developmental processes. Prevention Science, 15, 59–69.

Cha C, Franz P, Guzmán M, E., Glenn C, Kleiman E, & Nock M (2018). Annual Research Review: Suicide among youth–epidemiology, (potential) etiology, and treatment. Journal of Child Psychology and psychiatry, 59, 460–482. [PubMed: 29090457]

Collins L, Murphy S, & Bierman K (2004). A conceptual framework for adaptive preventive interventions. Prevention science, 5, 185–196. [PubMed: 15470938]

Connell A, & Dishion T (2008). Reducing depression among at-risk early adolescents: Three-year effects of a family-centered intervention embedded within schools. Journal of Family Psychology, 22, 574–585. [PubMed: 18729671]

Connell A, & Dishion T (2016). Long-term effects of the family check-up in public secondary school on diagnosed major depressive disorder in adulthood. Journal of youth and adolescence, 1–12.

Connell A, McKillop H, & Dishion T (2016). Long-Term Effects of the Family Check-Up in Early Adolescence on Risk of Suicide in Early Adulthood. Suicide and life-threatening behavior, 46, S15–S22. [PubMed: 27094106]

Connell A, Shaw D, Wilson M, Danzo S, Weaver-Krug C, Lemery-Chalfant K, & Dishion T (2019). Indirect effects of the early childhood Family Check-Up on adolescent suicide risk: The mediating role of inhibitory control. Development and Psychopathology, 31, 1901–1910. [PubMed: 31370914]

Connell A, Stormshak E, Dishion T, Fosco G, & Van Ryzin M (2018). The Family Check Up and adolescent depression: An examination of treatment responders and non-responders. Prevention Science, 19, 16–26. [PubMed: 26267390]

Curtin SC, Warner M, & Hedegaard H (2016). Increase in suicide in the United States, 1999–2014. NCHS Data Brief, No. 241, 1–8.

Derogatis L, & Fitzpatrick M (2004). The SCL-90-R, the Brief Symptom Inventory (BSI), and the BSI-18. In Maruish ME (Ed.), The use of psychological testing for treatment planning and outcomes assessment: Instruments for adults (p. 1–41). Lawrence Erlbaum Associates.

Dise-Lewis J (1988). The life events and coping inventory: an assessment of stress in children. Psychosomatic medicine, 50, 484. [PubMed: 3186892]

Dishion T, Brennan L, Shaw D, McEachern A, Wilson M, & Jo B (2014). Prevention of problem behavior through annual family check-ups in early childhood: Intervention effects from home to early elementary school. Journal of Abnormal Child Psychology, 42, 343–354. [PubMed: 24022677]

Dishion T, Shaw D, Connell A, Gardner F, Weaver C, & Wilson M (2008). The family check-up with high-risk indigent families: Outcomes of positive parenting and problem behavior from ages 2 through 4 years. Child Development, 79, 1395–1414. [PubMed: 18826532]

Dishion T, Stormshak E, & Kavanagh K (2012). Everyday parenting: A professional's guide to building family management skills. Champaign, IL, US: Research Press.

Fosco G, Van Ryzin M, Connell A, & Stormshak E (2016). Preventing adolescent depression with the family check-up: Examining family conflict as a mechanism of change. Journal of Family Psychology, 30, 82 – 92. [PubMed: 26414418]

Frey L, & Cerel J (2015). Risk for suicide and the role of family: A narrative review. Journal of Family Issues, 36, 716–736.

Glenn C, Esposito E, Porter A, & Robinson D (2019). Evidence base update of psychosocial treatments for self-injurious thoughts and behaviors in youth. Journal of Clinical Child & Adolescent Psychology, 48, 357–392. [PubMed: 31046461]

Gottfredson N, Cole V, Giordano M, Bauer D, Hussong A, & Ennett S (2019). Simplifying the implementation of modern scale scoring methods with an automated R package: Automated moderated nonlinear factor analysis (aMNLFA). Addictive behaviors, 94, 65–73. [PubMed: 30385076]

Hu L, & Bentler P (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling, 6, 1–55.

Hussong A, Curran P, & Bauer D (2013). Integrative data analysis in clinical psychology research. Annual review of clinical psychology, 9, 61–89.

Janiri D, Doucet G, Pompili M, Sani G, Luna B, Brent D, & Frangou S (2020). Risk and protective factors for childhood suicidality: a US population-based study. The Lancet Psychiatry, 7, 317–326. [PubMed: 32171431]

Kerr D, DeGarmo D, Leve L, & Chamberlain P (2014). Juvenile justice girls' depressive symptoms and suicidal ideation 9 years after multidimensional treatment foster care. Journal of Consulting & Clinical Psychology, 82, 684–693. [PubMed: 24731234]

Kovacs M (1992). Children's depression inventory. North Tonawanda, NY: Multi-Health Systems.

Lewinsohn PM, Rohde P, Seeley JR, & Baldwin CL (2001). Gender differences in suicide attempts from adolescence to young adulthood. Journal of the American Academy of Child & Adolescent Psychiatry, 40, 427–434. [PubMed: 11314568]

Linker J, Gillespie NA, Maes H, Eaves L, & Silberg JL (2012). Suicidal ideation, depression, and conduct disorder in a sample of adolescent and young adult twins. Suicide and Life-Threatening Behavior, 42, 426–436. [PubMed: 22646517]

Miller W, & Rollnick S (2012). Motivational interviewing: Helping people change. Guilford.

Musci RJ, Kharrazi H, Wilson RF, Susukida R, Gharghabi F, Zhang A, … & Wilcox HC (2018). The study of effect moderation in youth suicide-prevention studies. Social Psychiatry and Psychiatric Epidemiology, 53, 1303–1310. [PubMed: 30088027]

Muthén L, & Muthén B (2020). Mplus. The comprehensive modelling program for applied researchers: user's guide, v8.5.

Pineda J, & Dadds M (2013). Family intervention for adolescents with suicidal behavior: a randomized controlled trial and mediation analysis. Journal of the American Academy of Child & Adolescent Psychiatry, 52, 851–862. [PubMed: 23880495]

Ramchand R, Gordon J, & Pearson J (2021). Trends in suicide rates by race and ethnicity in the United States. JAMA network open, 4(5), e2111563–e2111563. [PubMed: 34037735]

Robinson J, Bailey E, Witt K, Stefanac N, Milner A, Currier D, … & Hetrick S (2018). What works in youth suicide prevention? A systematic review and meta-analysis. EClinicalMedicine, 4, 52–91. [PubMed: 31193651]

Rose J, Roman N, Mwaba K, & Ismail K (2018). The relationship between parenting and internalizing behaviours of children: A systematic review. Early Child Development and Care, 188, 1468–1486.

Sandler I, Tein J, Wolchik S, & Ayers T (2016). The effects of the family bereavement program to reduce suicide ideation and/or attempts of parentally bereaved children six and fifteen years later. Suicide and Life-Threatening Behavior, 46, S32–S38. [PubMed: 27094109]

Shaffer D, Fisher P, Lucas C, Dulcan M, & Schwab-Stone M (2000). NIMH Diagnostic Interview Schedule for Children Version IV (NIMH DISC-IV): description, differences from previous versions, and reliability of some common diagnoses. Journal of the American Academy of Child & Adolescent Psychiatry, 39, 28–38. [PubMed: 10638065]

Shaw D, Connell A, Dishion T, Wilson M, & Gardner F (2009). Improvements in maternal depression as a mediator of intervention effects on early childhood problem behavior. Development and psychopathology, 21, 417–439. [PubMed: 19338691]

Stormshak EA, Connell A, & Dishion TJ (2009). An adaptive approach to family-centered intervention in schools: Linking intervention engagement to academic outcomes in middle and high school. Prevention Science, 10, 221–235. [PubMed: 19390971]

Stormshak E, Connell A, Véronneau MH, Myers M, Dishion T, Kavanagh K, & Caruthers A (2011). An ecological approach to promoting early adolescent mental health and social adaptation. Child Development, 82, 209–225. [PubMed: 21291438]

Stormshak E, DeGarmo D, Chronister K, & Caruthers A (2018). The impact of family-centered prevention on self-regulation and subsequent long-term risk in emerging adults. Prevention Science, 19, 549–558. [PubMed: 29101645]

Turecki G, & Brent D (2016). Suicide and suicidal behaviour. Lancet, 387, 1227–1239. [PubMed: 26385066]

Véronneau M, Dishion T, Connell A, & Kavanagh K (2016). A randomized, controlled trial of the family check-up model in public secondary schools: Examining links between parent engagement and substance use progressions from early adolescence to adulthood. Journal of Consulting and Clinical Psychology, 84, 526. [PubMed: 27054823]

Vidot D, Huang S, Poma S, Estrada Y, Lee T, Prado G (2016). Familias Unidas' crossover effects on suicidal behaviors among Hispanic adolescents: results from an effectiveness trial. Suicide & Life Threatening Behaviors, 46, S8–14.

Wall M, Park J & Moustaki I (2015). IRT modeling in the presence of zero-inflation with application to psychiatric disorder severity. Applied Psychological Measurement, 39, 583–597. [PubMed: 29881029]

World Health Organization (1997) Composite International Diagnostic Interview – Version 2.1. Geneva: World Health Organization.

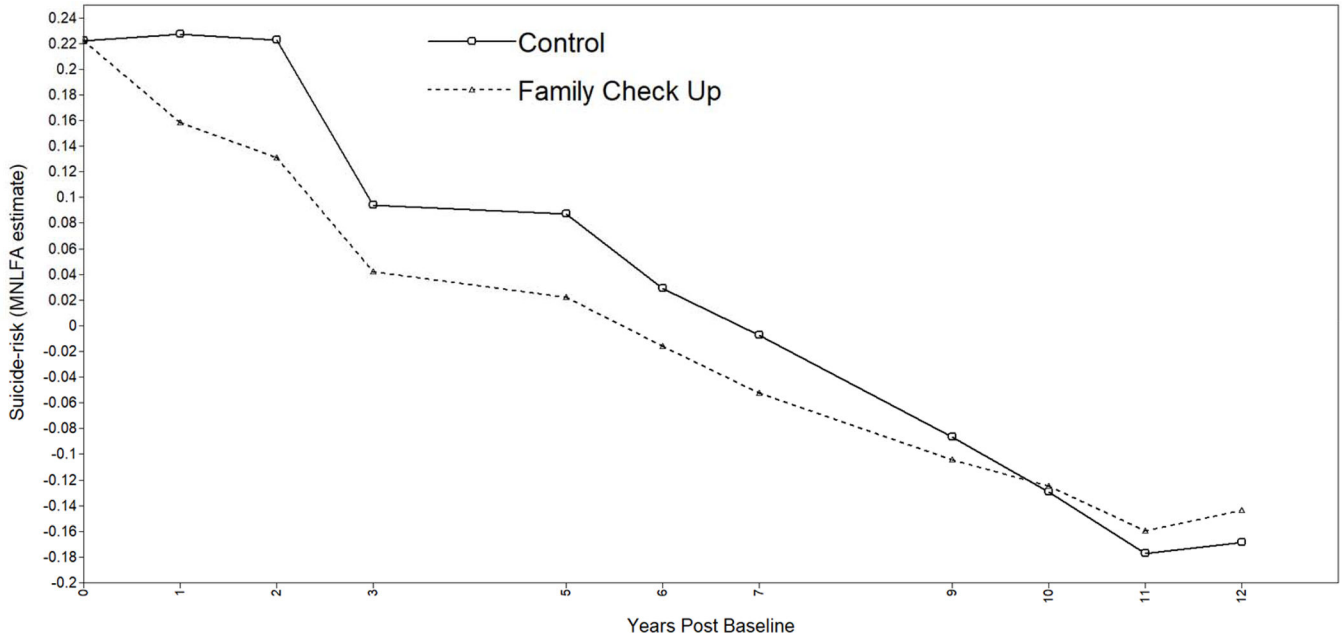

Figure 1.
Intervention effect on suicide-risk trajectories across three prevention trials.

Table 1.

Total sample sizes by study at each assessment wave.

Study	Reporter	Years Post-Baseline											
		0	**1**	**2**	**3**	**5**	**7**	**9**	**10**	**11**	**12**	**14**	**17**
PAL1	Youth	389	407	239		796	808	425		818	856		754
	Parent	140	144	81			648						
	Teacher	147	145	74									
	Youth Age:	*11*	*12*	*13*		*16*	*18*	*20*		*22*	*23*		*28*
PAL2	Youth	180	120	54				415	388	360			
	Parent							321	273	221			
	Teacher												
	Youth Age:	*11*	*12*	*13*				*20*	*21*	*22*			
ES	Youth							482					
	Parent				614	568	588	567			558	584	
	Teacher					313	386	360			499		
	Youth Age:				*5*	*7.5*	*9.5*	*10.5*			*14*	*16*	

Notes: PAL1 refers to the Project Alliance 1 trial. PAL2 refers to Project Alliance 2 trial. “ES” refers to the Early Steps Multisite trial.