



# Long-term Effects of Adolescent Substance Use Prevention on Participants, Partners, and their Children: Resiliency and Outcomes 15 Years Later During the COVID-19 Pandemic

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Accepted: 16 May 2022 / Published online: 25 May 2022  
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## Abstract

We examined whether participation in adolescent substance use prevention programming can enhance long-term resilience into adulthood such that individuals were better able to cope with adversities during the initial months of the COVID-19 pandemic, yielding benefits for the individuals, their partners/spouses, and children; 197 adults (28–30 years old) who entered the PROSPER randomized trial of substance use prevention programming as 6th graders and subsequently had become parents—and 128 of their partners—participated in two waves of long-term follow-up data collection. Respondents completed questionnaires on substance use, adjustment, parenting quality, and children’s mood and behavior problems 15 years after baseline, and again via an online survey in the first three months of the COVID-19 pandemic. Results were mixed, with some indications of better adjustment of PROSPER intervention compared to control participants during the early phase of the pandemic (less increase in alcohol use and less decrease in parenting warmth) and their children (lower levels of externalizing and internalizing problems) but several null results as well (no differences in other substance use behaviors, other parenting measures, or parent depression). Adolescent substance use prevention programs can foster long-term individual and interpersonal resilience factors that allow participants—as well as their children—to adapt and cope with unforeseen periods of acute stress and adversity with less deterioration in health and well-being.

**Keywords** Prevention · Resilience · Substance use · Parenting · Children’s mental/behavioral health

## Introduction

An estimated 60% of the population-attributable risk of all-cause mortality in the USA is due to unhealthy lifestyle behaviors such as inadequate physical activity, poor-quality diet, and substance use (Li et al., 2018; Van Dam et al., 2008). This high level of mortality and related morbidity is particular to the USA, where the number of preventable years of life lost per capita is 50–100% *higher* than in Japan

and most European countries (OECD, 2021). To reduce these health and cost burdens, the dissemination of effective behavior-change prevention strategies is critical. For the past half-century, the leading front of prevention strategy development, testing, and dissemination has been in the area of substance use, which is responsible for the majority of preventable mortality (Esser et al., 2020; National Institute on Drug Abuse, 2020). Over this period, universal prevention programs targeting adolescents have demonstrated the capacity to lower population-level rates of substance use. However, the dissemination of such programs is limited (National Academies of Sciences & Medicine, 2019). To demonstrate the value of substance use prevention strategies to policymakers, it is critical to assess whether the benefits of adolescent-focused prevention persist into adulthood; however, according to the US Surgeon general, we know little about this question (US Dept. of Health and Human Services, 2016).

Given the limited funding available for prevention implementation, most communities are unable to implement

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multiple prevention programs that target specific adolescent problems (e.g., depression, anxiety, sexual risk, violence, suicide, school dropout, academic achievement). Consequently, programs that yield “collateral benefits” or “cross-over” benefits (i.e., beneficial, but non-targeted intervention outcomes) are important to consider (Spoth et al., 2017, 2019), given that such programs target risk and protective factors that are common to multiple types of outcomes (Durlak, 1998).

Enhancing protective factors common to multiple outcomes could be viewed as promoting general “resiliency”—conceptualized as an individual’s ability to adaptively cope with stressors, challenges, and threats (Grych et al., 2015) in a way that facilitates health and well-being across outcome domains. Important resiliency factors include improved self-regulation, motivation to proactively address challenges (Skinner & Pitzer, 2012) (Spoth et al., 2019), and effective problem-solving skills (Boustani et al., 2015).

The idea that universal prevention programming may promote a general resiliency factor is supported by research on substance use prevention programs. Most such outcome research on the collateral benefits of substance use prevention examine closely related problem behaviors, such as delinquency and antisocial behavior (Doran et al., 2012). In addition, there is evidence of cross-over effects on internalizing problems (Mason et al., 2007).

### Long-term Follow-up of Substance Use Prevention Outcomes

A key rationale for targeting early adolescence in prevention programming is that the early onset of substance use predicts the presence and severity of substance use disorders and problems in early adulthood—which itself represents the highest risk period for drinking and drug use over the life course (Windle & Windle, 2012). Although researchers have infrequently followed participants in substance use prevention trials into adulthood to assess the hypothesized long-term impacts (Skara & Sussman, 2003), evaluations of three multi-component substance use prevention strategies have assessed outcomes over long follow-up periods. The Midwestern Prevention Project, which implemented a school-based 6th-grade program and a 7th-grade family program (Pentz et al., 1990), yielded long-term intervention effects on participants’ reports of their own warm parenting and their children’s impulsive behavior when participants were 28 to 32 years old (Riggs et al., 2009).

In two other projects with long-term follow-up data, the initiatives created a “community operating system” designed to deploy evidence-based prevention programs such as Life Skills Training (Botvin, 2000). Although the PROSPER and Communities That Care (CTC) initiatives differ in a number of ways, they both provide training and technical assistance

to local coalitions of community residents, service providers, educators, and agency officials; these coalitions then plan, select (from a menu provided by investigators), and deploy evidence-based prevention programs (Hawkins et al., 2008; Spoth et al., 2017). In a 24-community randomized trial, researchers demonstrated the impact of CTC on the proportion of adolescents who have initiated substance use (i.e., “lifetime use” or conversely, “sustained abstinence”) from early adolescence through 10th grade (Hawkins et al., 2012), as well as during emerging adulthood (Kuklinski et al., 2021; Oesterle et al., 2015; Oesterle et al., 2018). However, in further follow-up assessments, researchers failed to find the program’s impact on current (*i.e.*, past month and past year) substance use at ages 19, 21, or 23 (Oesterle et al., 2015, 2018).

The PROSPER model is a community-school-university partnership framework. The results of a randomized trial of PROSPER in 28 communities also found reduced levels of substance use among students in intervention communities during high school as well as during emerging adulthood one year after graduation (Spoth et al., 2017). However, the PROSPER results at ages 23 and 25 replicated the contours of the CTC long-term evaluation: Although the intervention impact on rates of lifetime use remained for some types of lifetime substance misuse, there were no longer intervention effects on the recent use of most substances that had been observed earlier: there was only one positive finding at each of the two waves (cigarette use at age 23 and nonprescribed narcotic use at age 25) (Spoth et al., 2022). Most positive findings on lifetime or current use were evident only in growth analyses (Spoth et al., 2022). However, even if intervention effects did not reliably persist at age 25, it is possible that latent resilience engendered by the adolescent-period interventions persisted and *mitigated increases* in substance use or other individual and family problems during periods of stress or crisis.

### Resiliency and Substance Use Prevention

Resilience has been conceptualized as a multi-factorial construct consisting of biopsychosocial processes that promote adaptation to threat or risk. We view resilience factors as a subset of the more general category of protective factors—which can include environmental, social context, and individual factors that are protective in a specific but not general manner (e.g., alcohol refusal skills). Key dimensions of an individual’s “resilience portfolio” (Grych et al., 2015)—relevant for a range of stressors and crisis situations—include an individual’s problem-solving and social-emotional capacities. Such social-emotional capacities include an ability to be aware of and respond to one’s own and others’ emotions, maintain close relationships, and offer and elicit social support when needed. Moreover,

Grych et al. (2015) suggest there is a reciprocal process in which strengthened resilience portfolios lead to healthier functioning and better well-being, which in turn leads to increased resilience capacities. (Grych et al., 2015).

In addition to providing information and strategies around substance use per se, adolescent substance use prevention programs frequently target these resilience factors as they contribute to youths' ability to avoid substance use. Boustani et al. (2015) analyzed the content of 15 effective substance use prevention programs for children and adolescents and found that five of the six most common areas of practice corresponded to the key resiliency factors mentioned above (i.e., problem-solving, coping skills, communication, assertiveness, and social skills). The substance use prevention programs on the PROSPER menu (Life Skills Training, Project Alert, All Stars, and the Strengthening Families Program, for youth ages 10–14) all promote such protective factors in addition to specifically targeting substance use (Botvin, 2000). For example, a close analysis of the Strengthening Families Program 10–14 (SFP 10–14) attendance and outcome patterns found that curriculum content related to self-regulation/stress management was one of the three leading content areas influencing program outcomes (LoBraico et al., 2019).

Evidence indicates that PROSPER did enhance protective factors linked to resilience capacities, in addition to reducing levels of substance use initiation and misuse. After the implementation of PROSPER's two-year sequence of a family-focused and school-based prevention program, intervention participants reported better problem-solving and assertiveness—as well as better relationship quality with parents and less association with risky peers—at the end of 7th, 8th, and 9th grades than control participants (Redmond et al., 2009). It appears that these short-term PROSPER intervention effects may have set in motion the further development of youths' "resilience portfolio" as participants matured and transitioned into adulthood: Our team found that program impacts on problem-solving were linked to improvements in the grades of participants in college (Spoth et al., 2019).

In the reciprocal interplay between resiliency and well-being, in young adulthood, the development of a positive romantic relationship serves as a key source of social support—a coping resource—that supports individual adaptation to stress (Cutrona, 1996). Following a subsample of PROSPER youth into young adulthood, we found that intervention participants reported better romantic relationship functioning in young adulthood (LoBraico et al., [under review](#)) than control youth. That analysis found a developmental cascade from enhanced, improved problem-solving capacity reported by intervention youth

during early to mid-adolescence predicting better family functioning during mid-adolescence, which in turn predicted lower levels of relationship violence and more effective relationship problem-solving in young adulthood.

The onset of the pandemic and associated public health intervention disruptions to work, school, income, and social connections posed a significant challenge to the well-being of parents, children, and families (Prime et al., 2020)). In a different sample, we found large deteriorations in parent and children's adjustment and family relationships in a wave of data collected before the pandemic to the first months of the pandemic (Feinberg et al., 2021). In that context, parents' social-emotional and problem-solving capacities—including interparental problem-solving and support—likely would have been important factors influencing individual and family well-being (DeGarmo & Forgatch, 2012; Dix, 1991; Mayordomo et al., 2016; Prime et al., 2020). These capacities support parents' ability to minimize maladaptive coping strategies, such as substance use, social withdrawal, or aggression (Wills & Filer, 1996), while maximizing adaptive coping including the maintenance of positive family relationships (Blechman et al., 1995; Wadsworth et al., 2005). This view is supported by findings from another long-term prevention trial of a family program which focused on factors such as self-regulation, problem-solving, and supportive interpersonal relations in the context of the coparenting relationship—a related but distinct construct from romantic relationship quality—at the transition to parenthood. This study showed a long-lasting intervention impact during the pandemic, ten years after intervention (Feinberg et al., [Under review](#)): Relative to control parents, intervention parents reported higher levels of mental health, lower levels of child problems, and better-quality couple, parent–child, and sibling relationships in the first months of the pandemic.

Thus, PROSPER's long-term collateral benefits may not be limited to the intervention participants themselves: As intervention participants experienced better romantic relationship quality, so too did their partners, with potentially positive implications for partners' resiliency and well-being. Moreover, for participants and partners with children, more positive interparental relations and individual well-being would likely then result in warmer, more sensitive, less harsh, and more consistent parenting toward children (Feinberg, 2002, 2003). Thus, if PROSPER had a meaningful impact on study participant's resilience portfolio over development, we would *expect* that their close relationships with family members such as partners or children would be more positive and, as a consequence, family members would also show less distress, better mental health, and better adaptive coping.

## The Current Study

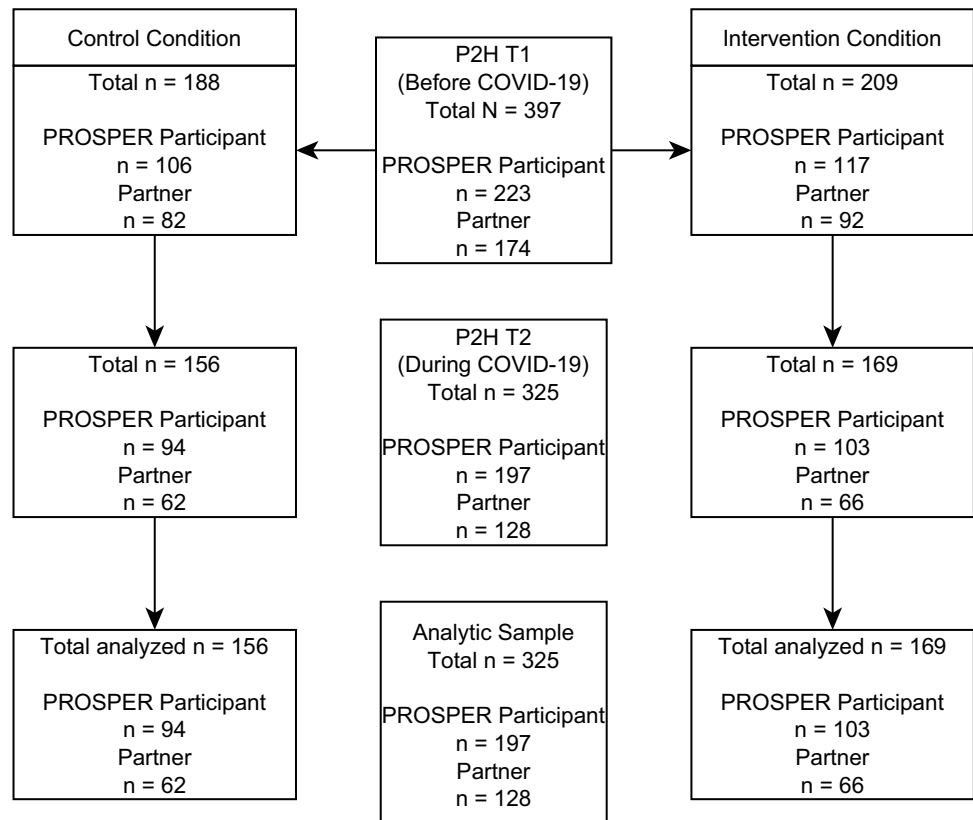
In this study, we utilize a subsample of PROSPER participants and their partners who had participated in a home-based assessment for a study of the intergenerational impact of PROSPER in the two years prior to the pandemic onset. As resilience is best assessed in response to adversity (Grych et al., 2015), we assess whether participants' assignment to the PROSPER intervention condition in 6th grade promoted long-term resilience by testing whether *future* harmful effects of risk exposure (i.e., the pandemic) were mitigated among the intervention condition participants, partners, and children. Thus, we test whether PROSPER participants' and their partners and children demonstrated relatively better coping and adjustment (e.g., substance use, mental health, and family relationships) 15 years later during the first 3 months of the COVID-19 pandemic. To summarize, we utilize the onset of the COVID-19 pandemic and attendant public health restrictions as a set of adversities against which we measure PROSPER participant resilience, operationalized as a smaller deterioration in well-being in the first months of the pandemic among intervention relative to control participants.

## Methods

### Procedures

All participants had either taken part in the original PROSPER randomized trial (pretest  $N = 10,845$ ) starting in 6th grade or were a spouse, romantic partner, or co-caregiver (i.e., coparenting family member/friend) of a child of a PROSPER participant. PROSPER (R01-DA013709, PI: Spoth) was designed to test a community-school-university partnership approach to substance use prevention delivery (Spoth et al., 2004); 28 school districts in Iowa and Pennsylvania were matched and randomly assigned to intervention or control conditions. Intervention communities delivered a sequence of family and school-based prevention programs for 6th and 7th graders (see Spoth et al., 2004, for details). Due to the use of passive parent consent procedures, over 90% of students in two sequential 6th grade cohorts participated; 6th-grade participants were followed annually with school surveys through 12th grade, and a randomly selected follow-up sample ( $N = 1984$ ) was assessed with online questionnaires during emerging adulthood at ages 19, 22, and 24 (Fig. 1).

**Fig. 1** Flow of participants through each stage. Control and intervention condition refers to the original PROSPER trial randomization. The analytic sample consists of PROSPER participants and partners who participated at both T1 and T2. Nine P2H participants joined the study at T2 during the pandemic without completing the T1 assessment; they were not included in this flow diagram



For this study, we invited 337 PROSPER participants in their mid-to-late 20 s to participate; all had reported being a parent of a child between the ages of 1.5 and 7 either during the emerging adulthood surveys or during additional email and telephone recruitment for this study. Of those 337, 223 agreed to participate in the intergenerational (P2H) substudy. We conducted home visits starting in 2018 (T1) to assess parent and partner/coparent mental health, parenting quality, family environment, and child adjustment; 174 partners or other co-caregivers of the 223 PROSPER participants also participated in P2H home visits and/or questionnaire data collection. Recruitment and home visits were paused with the onset of the COVID-19 pandemic in March 2020. P2H participants were then invited via email and telephone to complete a further online questionnaire in May 2020 (T2) regarding adjustment during the pandemic; 197 PROSPER participants and 128 of their partners or co-caregivers completed the online questionnaire. The Penn State IRB approved procedures, including consent such that participants signed informed consent forms at T1 and agreed with consent provisions presented at the beginning of the online survey by continuing with the survey (T2).

## Participants

197 PROSPER participants and 128 partners and other co-caregivers ( $M_{\text{age}} = 28.99$ ,  $SD_{\text{age}} = 5.79$ ; 60% female) participated in P2H study assessments both before (T1) and during the early phase of the COVID-19 pandemic (T2); 52% of participants were in the intervention condition or a partner/co-caregiver of a participant in the intervention condition.

The majority of participants were parents of the target child in the study (89.6%), with the rest self-identified as stepparents (5.2%), extended family members (3.7%), partners of parents (0.9%), and other (0.6%). The majority of the participants self-identified as White/Caucasian (88.6%), followed by Black/African American (3.4%), American Indian, Eskimo or Aleut (0.3%), and “Other” or having more than one racial background (7.1%). One-third (32.9%) of the participants completed high school or GED, 28.6% completed some college, 24.3% held an undergraduate degree, 12.3% held a graduate degree, and 1.8% had less than high school education. Most participants were employed (68.6% full-time, 12.6% part-time), and 18.8% reported being unemployed. Target children (45% female) in these families were on average 4 years old ( $SD = 2.11$ ) at T1. PROSPER participants reported living with the other parent/co-caregiver for an average of 5.9 years.

## Measures

**Alcohol** Frequency of drinking was measured at T1 and T2. At T1, participants responded to an open-ended question: “During the past month, how many times have you had alcoholic beverages?” At T2, the question was worded slightly differently: “In the past two weeks, how many days did you drink alcoholic beverages?” The response scale ranged from 0 to 14. Responses to both questions were recoded to reflect drinking frequency per week.

**Cigarette** Frequency of cigarette smoking was assessed at T1 and T2. At T1, participants were asked, “How often did you smoke cigarettes in the past month?” At T2, participants responded to the question, “In the past 2 weeks, how often did you smoke cigarettes?” Response categories differed slightly between T1 and T2. As a result, responses to both questions were recoded to have comparable ranges and categories. Recoded smoking frequency ranged from 1 = *not at all*, 2 = *less than 1 cigarette per day*, 3 = *1 to 5 cigarette per day*, to 4 = *more than 5 cigarette per day*.

**Vape** Frequency of vaping was measured at T1 and T2. At T1, participants were asked, “During the past month, how often did you use vaporizers?” At T2, the question was “In the past 2 weeks, how often did you use electronic vapor products?” At both times, response scale ranged from 1 = *not at all*, 2 = *less than once per day*, 3 = *1 to 5 times per day*, 4 = *5–10 times per day*, 5 = *10–20 times per day*, to 6 = *more than 20 times a day*.

**Marijuana** Frequency of marijuana use was assessed at T1 and T2. At T1, participants responded to an open-ended question: “In the past month, how many times have you used marijuana?” At T2, the question was worded slightly differently: “In the past two weeks, how many days have you used marijuana?” with a response scale ranging from 0 to 14. Responses to both questions were recoded to reflect marijuana use frequency per week.

**Depression** Depressive symptoms were measured at T1 and T2 using 10 items ( $\alpha_{T1} = 0.85$ ,  $\alpha_{T2} = 0.90$ ) from the Center for Epidemiological Studies-Depression (CES-D) scale (Radloff, 1977). Sample items included “How often did you feel depressed?” “How often was your sleep restless?” and “How often did you feel that people disliked you?” The response scale ranged from 1 = *rarely or none of the*

time (less than once a week), 2 = some or a little of the time (1–2 days a week), 3 = occasionally or a moderate amount of the time (3–4 days a week), to 4 = most or all of the time (5–7 days a week).

**Hostility** Hostility was assessed at T1 and T2 with 4 items ( $\alpha_{T1} = 0.72$ ,  $\alpha_{T2} = 0.84$ ) from the Symptom Checklist-90 (SCL-90) hostility subscale (Derogatis & Cleary, 1977). Participants were asked how much they were distressed by “feeling easily annoyed or irritated,” “temper outbursts that you could not control,” “having urges to break or smash things,” and “getting into frequent arguments.” Responses ranged from 1 = *not at all* to 4 = *extremely*.

**Parenting warmth** Parental warmth was measured at T1 and T2 using 5 items ( $\alpha_{T1} = 0.68$ ,  $\alpha_{T2} = 0.78$ ) from the Parental Attitudes toward Child Rearing (PACR) warmth scale (Goldberg & Easterbrooks, 1984). Participants rated their level of agreement on statements such as “I felt that [my child] and I had warm, intimate times together” on a scale ranging from 1 = *strongly disagree* and 6 = *strongly agree*.

**Harsh parenting** Harsh parenting was assessed at T1 and T2 with 3 items ( $\alpha_{T1} = 0.66$ ,  $\alpha_{T2} = 0.71$ ) from the Parenting Scale (Arnold et al., 1993). Participants rated their behaviors toward the child when they were upset or under stress, or when the child misbehaved, with a 7-point response scale. For example, “When [child name] misbehaves... 1 = I raise my voice or yell. 7 = I speak to [child name] calmly.” Responses were recorded such that higher scores indicated higher levels of harsh parenting.

**Family conflict** Family conflict was measured at T1 and T2 using 3 items ( $\alpha_{T1} = 0.81$ ,  $\alpha_{T2} = 0.85$ ) from the shortened Family Environment Scale (Bloom, 1985). Participants reported how often family members “quarreled,” “showed dislike for someone,” and “got upset or angry.” Response categories differed slightly between T1 and T2. As a result, both T1 and T2 responses were z-transformed with higher scores indicating more frequent family conflict.

**Life satisfaction** Life satisfaction was assessed at T2 with 2 items ( $r = 0.74$ ): “I felt content” and “I was satisfied with my life.” The response scale ranged from 1 = *rarely or none of the time (less than once a week)*, 2 = *some or a little of the time (1–2 days a week)*, 3 = *occasionally or a moderate amount of the time (3–4 days a week)*, to 4 = *most or all of the time (5–7 days a week)*.

**Child adjustment** At T1, child adjustment was measured using the Child Behavior Checklist (CBCL) (Achenbach & Rescorla, 2000) externalizing and internalizing subscales. Given the age range of target children, two versions (1½–5

and 6–18) were used. These subscales demonstrate good reliability (externalizing: 1½–5  $\alpha = 0.91$ , 6–18  $\alpha = 0.86$ ; internalizing: 1½–5  $\alpha = 0.85$ , 6–18  $\alpha = 0.76$ ). T-score conversion was performed to allow for comparable externalizing and internalizing scores across all children for analysis. Child adjustment at T2 was measured using 10 items adapted from the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) and the Child Adjustment and Parent Efficacy Scale (CAPES; Morawska et al., 2014). The 5-item child problem behavior scale ( $\alpha = 0.69$ ) included “often loses temper,” “yells, shouts or screams,” and “rudely answers back to me.” The 5-item child emotional distress scale ( $\alpha = 0.80$ ) included “has many worries or often seems worries,” “is often unhappy, depressed or tearful,” and “seems unhappy or sad.” The response scale ranged from 0 = *never* to 3 = *usually*.

## Data Analysis

To examine the main effect of the intervention (control = 0, intervention = 1), we conducted separate models for each of the 9 outcomes. For outcomes with multiple time points, we used two-level multilevel models (MLMs) to examine the intervention effect on pre-pandemic level (intercept) as well as change in levels across time (slope). (We did not include school district as a level in the models as ICCs for outcomes were very low—i.e., most were below 0.03, and only two were above 0.05.) Measurement time points were nested in individuals (coded as T1 = 0, T2 = 1; note that as the duration between T1 and T2 did not significantly differ between conditions, we did not include duration between time points as a covariate in the models). In the MLMs, original PROSPER participants and their caregiving partners were modeled in each model simultaneously but separately. At level 1, we regressed PROSPER participants’ and their caregiving partners’ scores on time, respectively, to examine whether there were significant changes in the outcome between T1 and T2. At level 2, we regressed PROSPER participants’ and their caregiving partners’ intercepts and slopes on intervention status, respectively, to examine whether there were significant intervention effects on PROSPER participants’ and/or their partners’ intercepts and/or slopes. These models are “multivariate,” as participant and partner estimates (i.e., intercept and slope) correlated at both within and between levels. Effect sizes were calculated as the unstandardized regression coefficient for the intervention term divided by the square root of the between-level variance in the outcome variable to create a standardized difference score. All multi-level models were conducted using Mplus 8.3.

For child externalizing and internalizing problems, which were measured with different instruments at T1 vs. T2, we included the T1 scores in models as covariates. To examine whether PROSPER participation status (caregiving

partner = 0, original PROSPER participant = 1) moderated the intervention effect, multiple regression models were estimated with an interaction term—Intervention Status  $\times$  PROSPER Participation. Results revealed that PROSPER participation status was not a significant moderator for either outcome. Therefore, we proceeded to use OLS regression models with a pooled sample of both original PROSPER participants and their caregiving partners and controlling for T1 child internalizing and externalizing problems. For life satisfaction which was measured at T2 only, we also tested whether PROSPER participation status was a significant moderator. Given that the interaction term was not significant, an OLS regression model with a pooled sample was carried out with intervention status as the only predictor. Effect sizes were calculated as Cohen's *d*. All regression models were conducted using SPSS 26.

### Transparency and Openness

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study. The study began before trial registration or preregistration

of an analytic plan was common or required; neither the trial methods nor analytic plan was preregistered. The data are not publicly available. Please contact the first author for measures or analytic code used in this study.

### Results

Descriptive statistics for study variables are presented in Table 1. Results from regression models are presented in Table 2. To assess baseline equivalence, we compared individuals in the intervention and control conditions on demographics (age, gender, education, employment) and T1 study variables (alcohol, cigarettes, vaping, marijuana, depression, hostility, warmth, harshness, conflict, and child externalizing/internalizing). Among original PROSPER participants, there were no significant differences between intervention and control participants. Among partners of participants, the only difference was just below  $p=0.05$  for depression: Intervention partners were less depressed ( $M=1.49$ ,  $SD=0.43$ ) than control partners ( $M=1.69$ ,  $SD=0.65$ ) ( $p=0.046$ ).

**Table 1** Descriptive information for study variables prior to (T1) and during (T2) the pandemic

Variable	PROSPER Participant ( $n=197$ )				Partner ( $n=128$ )			
	Intervention		Control		Intervention		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Parent outcome								
Alcohol (T1)	.57	1.89	.59	.99	.63	.98	.62	1.29
Alcohol (T2)	.58	.81	1.09	1.47	.88	1.39	1.22	1.52
Cigarette (T1)	1.60	1.09	1.71	1.14	1.43	1.00	1.71	1.23
Cigarette (T2)	1.59	1.13	1.79	1.23	1.32	.90	1.73	1.22
Vape (T1)	1.27	1.03	1.34	.99	1.22	.91	1.20	.75
Vape (T2)	1.24	.92	1.33	1.09	1.10	.64	1.22	.80
Marijuana (T1)	.25	1.09	.16	.81	.04	.29	.21	.96
Marijuana (T2)	.31	1.26	.82	2.15	.24	1.29	.45	1.57
Depression (T1)	1.62	.56	1.64	.53	1.49	.43	1.69	.65
Depression (T2)	1.69	.63	1.79	.65	1.52	.50	1.76	.74
Hostility (T1)	.49	.58	.55	.51	.41	.46	.50	.63
Hostility (T2)	.70	.77	.76	.66	.45	.52	.74	.76
Parenting warmth (T1)	5.53	.53	5.60	.48	5.47	.55	5.45	.79
Parenting warmth (T2)	5.53	.58	5.37	.74	5.33	.64	5.31	.70
Harsh parenting (T1)	3.21	1.16	3.30	1.24	3.13	1.19	3.06	1.26
Harsh parenting (T2)	3.34	1.15	3.54	1.32	3.44	1.19	3.36	1.25
Family conflict (T1)	-.16	.94	.07	1.10	-.05	.95	.20	.97
Family conflict (T2)	-.03	1.07	-.03	.97	-.12	.89	.23	1.02
Life satisfaction (T2)	3.21	.88	2.96	.91	3.44	.68	3.15	.96
Child outcome								
Externalizing (T1)	48.46	10.53	47.85	8.73	46.48	11.15	49.07	9.47
Behavior problem (T2)	.89	.50	1.00	.58	.97	.57	1.19	.62
Internalizing (T1)	48.47	10.74	48.19	9.39	47.34	10.96	47.59	8.46
Emotional distress (T2)	.88	.57	1.00	.59	.89	.56	1.08	.55

**Table 2** Intervention main effects on intercept and slope in MLM and OLS regression models

Outcome		Intercept			Slope		
		Estimate	SE	<i>p</i>	Estimate	SE	<i>p</i>
<b>Parent functioning</b>							
Alcohol	Participant	−.01	.20	.97	−.50	.25	.05
	Partner	.02	.21	.93	−.38	.23	.10
Cigarette	Participant	−.10	.16	.53	−.11	.10	.28
	Partner	−.27	.18	.15	−.10	.08	.18
Vape	Participant	−.08	.14	.58	.02	.14	.90
	Partner	.05	.14	.71	−.09	.16	.59
Marijuana	Participant	−.16	.40	.70	−.34	.36	.34
	Partner	−.09	.29	.76	−.02	.49	.97
Depression	Participant	−.03	.08	.75	−.07	.08	.34
	Partner	−.13	.10	.20	−.03	.10	.77
Hostility	Participant	−.07	.08	.39	−.01	.11	.96
	Partner	−.08	.10	.41	−.16	.12	.19
Life satisfaction	Pooled	.27	.10	.01	—	—	—
<b>Parenting quality</b>							
Parenting warmth	Participant	−.07	.07	.35	.23	.10	.02
	Partner	.02	.12	.86	−.01	.15	.94
Harsh parenting	Participant	.06	.21	.78	−.11	.16	.48
	Partner	−.07	.16	.65	.04	.19	.84
Family conflict	Participant	−.24	.14	.10	.23	.17	.18
	Partner	−.22	.16	.18	−.10	.21	.64
<b>Child outcome</b>							
Problem behavior	Pooled	−.13	.06	.01	—	—	—
Emotional distress	Pooled	−.13	.06	.01	—	—	—

Unstandardized coefficients are reported. Significant findings are bolded. Condition coded with intervention = 1 and control = 0

**Parent substance use and adjustment** With respect to parent alcohol use, we did not find statistically significant intervention effects on intercepts (i.e., initial level) of alcohol use frequency. We found a significant intervention effect on the slope for change in alcohol use frequency for original PROSPER participants (effect size =  $-0.79$ ; 95% CI:  $-0.49$  to  $-1.08$ ): PROSPER participants in the intervention condition reported less increase in the frequency of alcohol use from T1 to T2, compared to PROSPER participants in the control condition. There was no statistically significant group difference between intervention and control conditions in initial levels and changes in parent cigarette use, vaping, or marijuana use. We also did not find statistically significant intervention effects for parent depression or hostility. However, findings for parent life satisfaction (assessed at T2 only) revealed that intervention participants and their partners reported greater life satisfaction than those in the control group ( $d=0.31$ ; 95% CI: 0.09 to 0.53). These effects were not different (i.e., no significant moderation was found) for those who were PROSPER participants compared to those who were partners of PROSPER participants.

**Parenting quality** There was no statistically significant group difference in initial levels of parenting warmth. But there was a significant intervention effect on change in parenting warmth (slope) for original PROSPER participants only (effect size = 0.76; 95% CI: 0.47 to 1.05): PROSPER participants in the intervention condition reported less decrease in parenting warmth from T1 to T2, compared to PROSPER participants in the control condition. There was no statistically significant group difference between intervention and control conditions for harsh parenting or family conflict.

**Child adjustment** We found statistically significant intervention effects for both child outcomes, with T1 child adjustment accounted for in the model. Regardless of PROSPER participation status, parents and caregivers in the intervention condition reported lower levels of child problem behavior ( $d=0.27$ ; 95% CI: 0.05 to 0.49) and emotional distress ( $d=0.26$ ; 95% CI: 0.04 to 0.48) at T2, compared to those in the control condition.



## Discussion

In this report, we examined the long-term, cross-over effects of universal adolescent-prevention programs implemented in a trial of the PROSPER delivery system for evidence-based substance use prevention programs. Our larger question was whether adolescent substance use prevention programs can build enduring resilience that helps individuals cope with future adversities. During the pandemic, we hypothesized that adults who had been exposed to substance use prevention programming during adolescence would, as a result of enduring resilience and better coping, report better adjustment for themselves, their partners, and young children. Specifically, we examined whether adults—who had been randomized to the PROSPER intervention condition in 6th grade—and their partners reported better individual functioning, parenting, and child adjustment in the first phase of the COVID-19 pandemic. To examine resiliency, we examined the degree of change in functioning and well-being from before the pandemic to the early phase of the pandemic. Overall, results were mixed with some indications of better adjustment of participants and their children, but several null results as well.

For the primary outcomes of the PROSPER intervention program, we found that intervention condition participants, but not partners, reported smaller increases in the frequency of alcohol use during the pandemic relative to control respondents. In the control condition, we observed fairly large increases in alcohol use in the first months of the pandemic compared to pre-pandemic reports, with parents reporting drinking alcohol on average twice as often as before the pandemic. Our findings suggest a large intervention effect ( $d = -0.79$ ), mitigating the increase in alcohol use found in the control condition. It is noteworthy that intervention effects were observed for change, but not for initial levels of alcohol use in our assessment prior to pandemic onset, when PROSPER participants were 26 to 28 years old. This finding is consistent with results from prior follow-up studies of this sample: At ages 19 and 24, no intervention main effects were found for recent alcohol use (Spath et al., 2022; Spoth et al., 2017). Thus, PROSPER's impact on alcohol use for the original study participants at ages 26–30 was likely protective, that is, observable only during a period in which participants responded to the acute stress of the pandemic with large increases in alcohol use. These findings provide support for our hypothesis that adolescent substance use prevention programs contribute to the development of youths' internal "resilience portfolio" (Grych et al., 2015). For example, the impact of PROSPER's adolescent substance use prevention programs on intervention participants' problem-solving ability and assertiveness in adolescence (Redmond

et al., 2009) may have persisted into adulthood, contributing to individual coping. This view is consistent with prior PROSPER reports finding cross-over effects on participants' relationship adjustment and academic achievement in emerging adulthood (LoBraico et al., [Under review](#); Spoth et al., 2019). Future analyses will examine whether PROSPER's effects on key resilience factors—such as problem-solving, assertiveness, and close relationships—mediated effects on participants' response to the onset of the pandemic.

PROSPER's impact on alcohol use during the pandemic may have had additional important ramifications which we did not measure. For example, research has linked alcohol use with a higher propensity for aggression, including intimate partner violence and harsh parenting (Foran & O'Leary, 2008; Miller et al., 1999). During the pandemic, many reports suggested that intimate partner violence within households increased during the pandemic (Boserup et al., 2020); and one study found such increases were an indirect result of increased alcohol use (Silverio-Murillo et al., 2020). Thus, we find it plausible—and a topic for future research—that adolescent substance use prevention buffered increases in alcohol use 15+ years later during a global health crisis, thereby protecting against increases in levels of intimate partner violence.

We did not observe an intervention effect for either form of nicotine use nor marijuana use. Changes in tobacco use (both cigarette smoking and vaping) in the control condition were much smaller relative to the increases in alcohol use; these smaller increases may have presented little opportunity to observe a protective effect of the intervention (i.e., a floor effect). There may be more fine-grained use patterns that would reveal different results: Intermittent smokers' frequency of use is more strongly influenced than is daily smokers' use by context (e.g., being away from home, socializing, being at a bar) (Shiffman et al., 2014). For marijuana, we note that the difference in the size of the change in use across conditions nonetheless seemed large. PROSPER participants in the control condition exhibited a large increase in the frequency of use (from average weekly marijuana use of 0.16 to 0.81), whereas the increase among intervention participants was much smaller (from 0.25 to 0.31).

We found no significant intervention effects on parents' mental health problems such as depressive symptoms or hostility. However, we did find an intervention effect on respondents' rating of life satisfaction. This finding held for both participants and partners pooled together, suggesting diffusion of long-term spillover effects of PROSPER from participants to romantic partners.

We reasoned that if parents in the intervention condition reported better functioning and well-being than control parents, they would demonstrate relatively better parenting quality toward their young child. We did not find an effect

in this area for negative parenting, which is strongly linked to parents' mental health problems. However, PROSPER intervention participants (not partners) reported less decline in parenting warmth than did control participants. Consistent with this finding, we also found that intervention condition parents reported lower levels of behavioral and emotional problems among their children than did control condition parents. This analysis controlled for a different measure of such behavior and emotional problems before the pandemic and thus may be viewed as a protective effect of the intervention; that is, the intervention protected families from increases in children's behavioral and emotional problems with the pandemic. In any case, this finding of better child adjustment in both behavioral and emotional dimensions, 15+ years after one parent had participated in adolescent substance use prevention programming, is an impressive indication of long-term, intergenerational spillover effects. These findings are also consistent with the evaluation results of the Midwestern Prevention Project, which demonstrated long-term intervention effects on participants' reports of their own warm parenting and their children's impulsive behavior (Riggs et al., 2009). These findings support further examination of the intergenerational impacts of prevention in order to document and assess the full benefits of public investment in adolescent substance use prevention.

Despite several advantages—such as a randomized controlled trial framework, careful measurement and analysis, and long-term follow-up data collected before and after the pandemic onset—this study had noteworthy limitations. First, we utilized self-report measures, and mono-method bias might have affected the results. Second, the rural/semi-rural school districts in PROSPER were largely White communities; although these are understudied communities, future work should examine such effects among diverse geographic and racial/ethnic samples. Third, given the sample size, we were unable to examine gender as a moderator of intervention effects.

In conclusion, we found evidence supporting the hypothesis that a limited dosage of adolescent substance use prevention led to an improved resiliency portfolio that persisted for 15+ years, leading to mitigation of deterioration in functioning during an acutely stressful period. We hypothesize that improved resiliency allowed participants to build romantic relationships and family arrangements with partners in a way that allowed both participants and their partners to experience a higher level of life satisfaction and adjust to a global health crisis with a less increase in alcohol use and a decrease in warm parenting relative to control condition study participants. Future work will assess whether the intervention effects on parent well-being and parenting mediated impacts on participants' children during the early acute stage of the pandemic.

This study indicates that intergenerational program impacts may represent a new area of economic savings for policymakers to consider. Further research should document an expanded range of societal savings due to the long-term main and protective effects of adolescent substance use prevention for both participants and family members. Currently, prevention programs typically target different outcomes (substance use, mental health, academic success, violence) and are largely funded and delivered by the government agency and administrative silos. The recognition of a core set of resiliency and common protective factors and the multifinality of intervention outcomes (Mason et al., 2007, 2008; Redmond et al., 2009; Spoth et al., 2008, 2014) supports calls for greater integration of prevention strategies at the *program curriculum level*. If facilitated by government support for integrated development, research, and dissemination, a cost-effective prevention strategy could target a set of core resiliency factors (Calhoun et al., 2020), with supplemental content provided around specific problem areas (e.g., substance use, depression, suicide, academic functioning).

**Funding** Data collection was funded by the National Institute of Child Health and Human Development R01-HD092439 and the Huck Institutes of the Life Sciences and the Social Science Research Institute at Pennsylvania State University (Co-PIs: Fosco & Feinberg). The parent study was funded by grant R01-DA013709 (PI: Spoth) from the National Institute on Drug Abuse.

## Declarations

**Ethics Approval** This study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. The Pennsylvania State University IRB approved all procedures and measures.

**Consent to Participate** Participants gave informed consent for all data collected.

**Conflict of Interest** Not applicable.

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