

Title: Investigating the Effects of an Early Childhood Intervention on Adolescent Substance Use

Joshua E. Ruf¹, Tyler W. Watts¹, Chen Li¹, C. Cybele Raver¹

¹ Steinhardt School of Culture, Education and Human Development, New York University, New York, New York, United States of America

Word Count: 981

Background/Context:

The role of adolescent substance use in adult health is well documented. Smoking in adolescence later sparks higher levels of nicotine dependency (Buchmann et al. 2013); marijuana use has been associated with impaired cognitive functioning and persistent lower academic achievement (Volkow et al. 2014); and alcohol consumption has been linked with abusive drinking in adulthood (Armitage et al. 2014). As such, programs to curb substance use in adolescence ought to receive more attention. While early childhood interventions have been shown to reduce crime and encourage high school graduation, little is known about their long-run effects on health (Campbell et al. 2014). In an effort to bridge this gap in the literature, we evaluated the long-run impact of the Chicago School Readiness Project (CSRP) on rates of substance use in adolescence.

Purpose/Objective/Research Question:

We investigated whether an early childhood intervention program, focused on teacher professional development and promoting student regulation, had long-term positive impacts on adolescent cigarette smoking, alcohol consumption, and marijuana use.

Setting:

Children in the current sample were recruited for participation in the intervention from Head Start centers in high-poverty areas of inner-city Chicago. They have been followed longitudinally through adolescence, and the majority still reside in inner-city Chicago.

Population/Participants/Subjects:

The original sample included 602 students who participated in the early intervention, and the current sample is limited to adolescents who had adolescent follow-up data (n= 490). The majority of children who participated in the intervention identified as Black (68%) and most came from families living below the poverty line.

Intervention/Program/Practice:

The CSRP provided teachers at Head Start centers in Chicago with access to targeted pedagogical development sessions as well as assistance from a mental health consultant one morning per week. These services were provided with the goal of improving student behavioral management in the classroom. Previous research by Raver and colleagues (2009; 2011) indicated that the program reduced children's behavioral problems and boosted their cognitive skills by the end of preschool, however, these effects were largely absent by elementary school. More recently, Watts et al. (2018) found suggestive evidence of long-run, positive, effects on adolescent measures of executive function and academic achievement.

Research Design:

The intervention was evaluated by using a pair-wise blocking procedure that matched Head Start centers to minimize systematic differences between treatment and control groups (see Raver et al. 2008). Random assignment occurred within these nine paired “blocking groups.” The CSRP intervention was implemented in the nine sites randomly assigned to the “treatment” group, and “control” sites continued Head Start “business as usual.” The intervention was implemented during the 2004-2005 and 2005-2006 academic years, and students have been followed through adolescence.

Data Collection and Analysis:

Measures of substance use were obtained from two long-run follow-up surveys conducted during the 2015-2016 and 2016-2017 academic years. In these surveys, children were asked to self-report whether they had ever smoked a cigarette, used an electronic cigarette or vapor product, used marijuana, or drank alcohol without adult permission. We aggregated cigarette use and electronic-cigarette use to create a more comprehensive ‘smoking’ measure that takes the value “1” if the student reported use of either smoking apparatus.

Table 1 shows baseline measures of student’s demographics as well as the distribution of outcome measures. By the second follow-up wave, 19.0% of children reported having smoked. Surprisingly, smoking status between waves was only moderately correlated ($r(435) = 0.364$). The prevalence of electronic cigarettes/vapes use was higher than that of regular cigarettes, and both alcohol and marijuana use with 22.0% and 25.7% of children reporting using these substances, respectively, by the second follow-up wave.

We began by examining the impact of the intervention program on student reports of substance use for each follow-up wave respectively before looking at responses pooled across both years (e.g., did a student ever smoke across both follow-up periods?). Estimates were determined with multiple independent linear probability models in which the binary outcome (smoking status, marijuana consumption, or alcohol consumption) was regressed on treatment status, blocking group fixed-effects, as well as baseline demographic information. Previous analyses by Watts et al. (2018) highlighted the imbalance of baseline characteristics between the treatment and control groups in this intervention, and the need to adjust for baseline covariates to recover unbiased estimates. As such, we followed their procedure of comparing models with and without covariates, and we checked for the consistency of the treatment impact estimate across these models. Robust standard errors were clustered at the Head Start center level using the White-Huber method. We employed a multiple imputation with chained equations technique to address missing information for all variables except the outcome variables.

Findings/Results:

As Table 2 indicates, we found little indication that the intervention program affected student-reported substance use in adolescence. In the fully-controlled model (Model 2), we found some indication that the treatment may have predicted higher reporting of smoking during the first follow-up wave ($\beta = 0.055$, $SE = 0.031$, $p = 0.069$). However, this pattern did not hold in the next year. Our models that tested whether a student ever reported having smoked at either follow-up wave also produced mainly null results, though we saw a small, marginally

statistically significant, positive treatment effect in the model that did not include baseline covariates ($\beta = 0.063$, $SE = 0.033$, $p = 0.0579$). Estimates for marijuana use and alcohol consumption were close to zero, and never statistically significant, across all models tested.

Conclusion:

In sum, our analyses do not suggest that the CSRP program significantly affected rates of substance use in adolescence. While some models indicate that the intervention increased rates of smoking, these estimates were imprecise and highly sensitive to covariate selection. As well, with observed imbalance between the treatment and control groups, it remains possible that our treatment effect estimates are influenced by unobserved factors. Future models will consider heterogeneous treatment effects to test whether the treatment may have had systematically varying impacts based on gender and race.

Table 1: Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Max
Treated	490	0.51	0.50	0	1
Child Demographics:					
Female	490	0.54	0.50	0	1
African American	490	0.68	0.47	0	1
Hispanic	490	0.26	0.44	0	1
Bi-Racial/Other/Non-White	490	0.04	0.19	0	1
Age at Wave 1 Survey	452	15.32	0.81	13.19	17.03
Age at Wave 2 Survey	437	16.19	0.77	14.19	17.78
Tobacco Outcome Measures:					
Smoking Status in Wave 1	461	0.14	0.35	0	1
Smoking Status in Wave 2	435	0.12	0.33	0	1
Smoking Status in Wave 1 or Wave 2	490	0.19	0.39	0	1
Cigarette Use in Wave 1	461	0.06	0.23	0	1
Cigarette Use in Wave 2	435	0.07	0.26	0	1
Cigarette Use in Wave 1 or Wave 2	490	0.09	0.29	0	1
Electronic Cigarette Use in Wave 1	461	0.11	0.31	0	1
Electronic Cigarette Use in Wave 2	434	0.09	0.29	0	1
Electronic Cigarette Use Status in Wave 1 or Wave 2	490	0.16	0.37	0	1
Marijuana Outcome Measures:					
Marijuana Use in Wave 1	461	0.17	0.37	0	1
Marijuana Use in Wave 2	435	0.22	0.41	0	1
Marijuana Use in Wave 1 or Wave 2	490	0.26	0.44	0	1
Alcohol Outcome Measures:					
Alcohol Consumption in Wave 1	461	0.14	0.35	0	1
Alcohol Consumption in Wave 2	435	0.16	0.37	0	1
Alcohol Consumption in Wave 1 or Wave 2	490	0.22	0.42	0	1

Notes: 1. Smoking Status refers to the use of either cigarettes or electronic cigarettes. Across the binary variables, 1 indicates "Yes" while 0 indicates "No". Means for binary variables report percentages of "Yes". Wave 1 occurred in the 2015-2016 academic year and wave 2 occurred in the 2016-2017 academic year.

Table 2: Treatment Impacts

	Model 1	Model 2
Cigarette or Electronic-Cigarette Use		
Treatment Impact in Wave 1 (N = 461)	0.052* (0.025)	0.056+ (0.031)
Treatment Impact in Wave 2 (N = 435)	0.017 (0.033)	-0.041 (0.035)
Treatment Impact in Wave 1 or Wave 2 (N = 490)	0.063+ (0.033)	0.022 (0.033)
Marijuana Use		
Treatment Impact in Wave 1 (N = 461)	0.001 (0.015)	-0.022 (0.024)
Treatment Impact in Wave 2 (N = 435)	0.004 (0.032)	-0.028 (0.030)
Treatment Impact in Wave 1 or Wave 2 (N = 490)	0.018 (0.023)	0.002 (0.021)
Alcohol Consumption		
Treatment Impact in Wave 1 (N = 461)	-0.002 (0.020)	0.007 (0.022)
Treatment Impact in Wave 2 (N = 435)	-0.006 (0.027)	-0.010 (0.033)
Treatment Impact in Wave 1 or Wave 2 (N = 490)	-0.003 (0.018)	0.014 (0.025)
Baseline Covariates Included		
Blocking Groups	X	X
Child Demographics		X
Home Information		X
Parent Information		X
Child Examination Scores		X
Teacher Information		X

Notes: Robust standard errors were adjusted for site-level clustering in preschool and are presented in parentheses. Estimates were obtained from OLS linear probability models so they can be interpreted as the increase in probability for the treatment group (relative to the control group). The 'Cigarette or Electronic Cigarette' outcome measure was also described as 'Smoking Status' in Table 1 and the body. Missing information for baseline covariates was handled using multiple imputation with chained equations; outcome measures were not imputed. Wave 1 occurred in the 2015-2016 academic year and wave 2 occurred in the 2016-2017 academic year.

+ p<0.10 * p< 0.05 ** p < 0.01 *** p < 0.001

References:

- Armitage, C. J., Rowe, R., Arden, M. A., & Harris, P. R. (2014). A brief psychological intervention that reduces adolescent alcohol consumption. *Journal of Consulting and Clinical Psychology, 82*(3), 546-550.
- Buchmann, A. F., Blomeyer, D., Jennen-Steinmetz, C., Schmidt, M. H., Esser, G., Banaschewski, T., & Laucht, M. (2013). Early smoking onset may promise initial pleasurable sensations and later addiction. *Addiction Biology, 18*, 947-954.
- Campbell, P., Conti, G., Heckman, J., Moon, S.H., Pinto, R., Pungello, E., Pan, Y. (2014). Early Childhood Investments Sustainability Boost Adult Health. *Science, 343*(6178), 1478-1485.
- Raver, C. C., Jones, S. M., Li-Grining, C., Zhai, F., Metzger, M. W., & Solomon, B. (2009). Targeting children's behavior problems in preschool classrooms: a cluster-randomized controlled trial. *Journal of Consulting and Clinical Psychology, 77*(2), 302.
- Raver, C. C., Jones, S. M., Li-Grining, C., Zhai, F., Bub, K., & Pressler, E. (2011). CSRP's impact on low-income preschoolers' preacademic skills: self-regulation as a mediating mechanism. *Child Development, 82*(1), 362-378.
- Volkow, N.D., Baler, R.D., Compton, W.M., Weiss, S.R.B. (2014). Adverse Effects of Marijuana Use. *New England Journal of Medicine, 370*, 2219-2227.
- Watts T.W., Gandhi J., Ibrahim D.A., Masucci M.D., Raver C.C. (2018). The Chicago School Readiness Project: Examining the long-term impacts of an early childhood intervention. *PLoS ONE, 13*(7): e0200144. <https://doi.org/10.1371/journal.pone.0200144>