EMPIRICAL RESEARCH

School-related Promotive Factors Related to Cannabis Use Among American Indian Adolescents

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Abstract

Reservation-dwelling American Indian adolescents are at exceedingly high risk for cannabis use. Prevention initiatives to delay onset and escalation of use are needed. School engagement and student's positive experiences at school have been identified as key promotive factors against cannabis use in the general population of adolescents, but little work has examined these factors among American Indian youth. Seven school-related promotive factors were examined as predictors of past 30-day cannabis use (measured 6 months later), controlling for previous onset of cannabis use as well as a set of relevant potential confounders. Models were tested using 280 adolescents in 6th or 7th grade at the start of the study from two reservation-based schools in the US. Students were surveyed three times, with 6 months in between each survey. The average age at the start of the study was 11.99 years (SD = 0.87) and 54% of participants were female. Using a cumulative logit model to predict past 30-day use, American Indian youth who reported greater school bonding, academic aspirations, proclivity to endeavor in their studies, and interest in school at Wave 2 reported less 30-day cannabis use at Wave 3 (controlling for onset of cannabis at Wave 1 and several other control variables). No evidence of an effect of self-reported grades, perceived safety, or participation in school-related extracurricular activities was found. Given substantial deterioration of these school-related promotive factors over time, and the effect of the school-related promotive factors on subsequent cannabis use, efforts to design and test interventions to promote school engagement as a protective measure against cannabis use is warranted.

Keywords American Indian adolescents · Cannabis use · School engagement

Introduction

Cannabis is the most frequently abused drug among American Indian adolescents, and rates of use among American Indian young people are substantially higher than the general population of US adolescents (Swaim & Stanley, 2018). With this disparity well-established, efforts to develop and test interventions to delay the onset of cannabis use and lessen use of cannabis by American Indian adolescents are needed. The identification of key risk, promotive, and protective factors is prerequisite to the effective design of such initiatives. In this study, school engagement is studied as a putative promotive factor against cannabis use for American Indian middle school youth.

Cannabis Use Among American Indian Adolescents

Cannabis use among reservation-dwelling American Indian adolescents exhibits a unique pattern compared to national U.S. adolescents. Typically, the most commonly used substance among adolescents is alcohol (Johnston et al., 2019); but cannabis is equally or more frequently used among American Indian adolescents (Swaim & Stanley, 2018). For example, in one recent population-based study (Swaim & Stanley, 2018), 43.7% of American Indian eighth graders reported lifetime cannabis use, while 39.7% reported lifetime alcohol use. In a comparable sample of US adolescents from the Monitoring the Future (MTF) study (Johnston et al., 2019), 12.8% reported lifetime cannabis and 22.8% reported lifetime alcohol use. The same pattern

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when contrasting cannabis to alcohol use across American Indian and national youth emerged for recent use. Among American Indian 8th graders 22.5% reported past 30-day use of cannabis and 15.8% reported past 30-day alcohol use. This is in comparison to 5.4% and 7.3% of MTF 8th graders who reported past 30-day use of cannabis and alcohol respectively. These comparative data demonstrate that American Indian adolescents use cannabis at a much higher rate in comparison to their peers, and their normative patterns of use relative to other drugs also departs from their peers.

While cannabis use among the general adolescent population is commonly studied, very few studies focus on American Indian adolescents and/or include enough American Indian adolescents to allow careful consideration of this vulnerable group. Those few studies have demonstrated concerning trends. A longitudinal study of North American Indigenous adolescents was conducted in the upper Midwest and Canada (Walls, Sittner Hartshorn, & Whitbeck, 2013). Patterns of past 30-day cannabis use from age 10 to 18 were examined. The prevalence of recent cannabis use rose sharply during early adolescence, approaching a predicted probability of near 0.3 by age 15. A longitudinal study of American Indian adolescents from the Northern Plains was conducted (Whitesell et al., 2012), with a focus on initiation of substance use. By age 13, well over 50% of adolescents in the study had initiated cannabis use. Based on national data, American Indian adolescents were found to suffer from cannabis disorder more frequently than other populations of adolescents (Wu, Woody, Yang, Pan, & Blazer, 2011). Among all American Indian adolescents sampled, 6.2% reported a cannabis use disorder in the past year. Among American Indian users of cannabis, 26.3% reported a cannabis use disorder in the past year. Taken together, these alarming use rates and patterns highlight the need for research focused on the etiology and prevention of cannabis use among American Indian adolescents.

Risk and Promotive Factors for Cannabis Use

Numerous individual and contextual factors are precursors to adolescent cannabis use and these variables span multiple contexts—including family, peer groups and school (Sloboda, Glantz, & Tarter, 2012). The goal of the present study was to focus on school-related promotive factors for American Indian adolescents—including school bonding, academic aspirations, endeavoring to succeed in school, interest in school work, academic grades, perception of safety at school, and participation in school-sponsored extracurricular activities. Positive school experiences such as these have been identified as important promotive factors against substance use, including cannabis use, in the general population of youth (Chapman, Buckley, Sheehan, &

Shochet, 2013; Li & Lerner, 2011), yet only a few studies have examined their efficacy among American Indian adolescents. Identification of salient school-related promotive factors that have the potential to prevent or lessen adolescent cannabis use among American Indian adolescents would offer a blueprint for the development of programs, practices and policies.

This study used data from the Our Youth, Our Future (OYOF) Study, an epidemiological survey research study of substance use, and related risk and promotive factors, among American Indian middle and high school students. Three Waves of data collected prospectively from a cohort of 6th and 7th grade American Indian students were used. Though not designed to specifically measure school engagement, the study included seven variables that measured or were relevant to school engagement—including school bonding, academic aspirations, endeavoring to succeed in school, interest in school work, grades in school, participation in school extracurricular activities, and a sense of safety at school. Because these variables are not the traditional measures of school engagement, they are referred to as school-related promotive factors in this paper.

The Importance of School-related Promotive Factors

For adolescents, school is a primary venue for socialization, education, and development. Positive experiences at school and success in school set the stage for a successful transition into adulthood (Wang & Eccles, 2012). Though many frameworks for conceptualizing students' school experiences exist, the concept of school engagement is one of the most often studied (Fredricks, Blumenfeld, & Paris, 2004). School engagement refers to the energized, directed, and sustained action of a child in the context of their school (Skinner, Furrer, Marchand, & Kindermann, 2008). There are four primary dimensions of school engagement: academic engagement (direct engagement in the learning process—completing homework, attentiveness in class), social engagement (following school expectations—attendance, positive interactions with staff and students), cognitive engagement (active pursuance of knowledge, persistence), and affective engagement (sense of belonging at school, affinity for the school environment and the people in it) (Finn & Zimmer, 2012). In line with this multidimensional approach to conceptualizing school engagement, Wang and Hofkens (2020) argue for a school-wide and multi-contextual perspective on school engagement—emphasizing that a narrow focus on student's academic engagement misses several key elements of a student's experience at school. Assessment of school engagement should encompass a wide range of academic activities and social interactions experienced as an adolescent navigates their school environment.

Strong theory supports the mechanisms by which the dimensions of school engagement promote positive youth development and protect youth from involvement in risky and problem behaviors, such as cannabis use. Social control theory (Gottfredson & Hirschi, 2019) and the social development model (Cambron, Catalano, & Hawkins, 2018) each posit that adolescents who are bonded with and engaged in school are more inclined to adhere to the pro-social norms and rules upheld by academic/school culture. Moreover, weakened social bonds to school mark a shift away from pro-social attitudes and norms, and toward involvement in risky and delinquent behaviors. This takes place as pro-social pursuits are replaced with a problematic trajectory of development, one that often culminates in high school dropout and a strained transition to prosperous adult roles (Rumberger, 1987).

Extending beyond the social control perspective, Paternoster and Pogarsky's (2009) theory of thoughtfully reflective decision making may offer a more nuanced perspective on young people's decision to be engaged in school. The authors argue that when making a decision, an individual must deliberately, carefully, and thoughtfully consider the pros and cons of different paths forward. With this perspective, a young person who engages in school is acting rationally and with agency to traverse a pro-social path toward positive youth development and a successful transition to adulthood. Thus, engagement in behaviors that will jeopardize success may be more readily discarded. In this way, school engagement may signal an adolescent's active choice to choose a pro-social path. Moreover, once school engagement is established, the act of engagement is likely to reinforce a cycle of attachment to pro-social institutions, involvement with pro-social peers, academic success, and a continued course of positive youth development (Skinner, Furrer, Marchand, & Kindermann, 2008).

It is important to note that the act of engagement (vs. disaffection) in school is not solely under the volition of the student. Rather, the school context plays a key role in facilitating or hindering the likelihood and degree of student engagement. The model of stage-environment fit (Gutman & Eccles, 2007) emphasizes that engagement is able to occur when the school context appropriately meets the student's social-emotional needs. When there is a mismatch between the student's needs and the offerings of the school environment, school engagement likely declines—in terms of disinterest, waning participation, and declining performance.

Change in School-related Promotive Factors over Time

Unfortunately for many youth, engagement declines over time, as disaffection becomes more common (Lam et al., 2014;

Wang & Eccles, 2012). This process of gradual disaffection from school may be more pronounced for American Indian children (Rees, Freng, & Winfree, 2014). Substantial disparities between American Indian and non-American Indian youth exist for many markers of academic success. For example, American Indian students score between two to three grade levels behind their non-Hispanic, White peers in both reading and math (National Caucus of Native American State Legislators, n.d.) and have the highest high school dropout rate of all race/ethnic groups (Hussar et al., 2020). However, little work has examined school engagement and related variables among American Indian adolescents, leaving the prevalence of school engagement, the manner in which it changes, and the ability of engagement-related variables to promote positive youth development and avoidance of health risk behaviors (including substance use) largely unknown in this population. Therefore, assessment of school engagement and related factors among American Indian youth is of critical importance.

School-related Promotive Factors and Cannabis Use among American Indian Adolescents

Several studies provide some evidence that these types of school-related promotive factors may help delay the onset of cannabis use and or/reduce the frequency of use among American Indian adolescents. Among a small sample of urban American Indian students, a sense of belonging was related contemporaneously with less substance use (a measure that included cannabis use), even after controlling for differing levels of academic achievement (Napoli, Marsiglia, & Kulis, 2003). Among reservation American Indian students ages 9–11, school bonding was related contemporaneously to drug refusal skills in general (Galliher, Evans, & Weiser, 2007). Among a mixed sample of urban and reservation American Indian students, higher perceived availability and more intense levels of participation in extracurricular activities were related contemporaneously to lower levels of substance use (a measure which included cannabis use) (Moilanen, Markstrom, & Jones, 2014). Finally, using a subsample of urban and reservation-based American Indian youth from two Waves of the National Longitudinal Study of Adolescent Health, American Indian youth who reported higher levels of school commitment reported lower levels of cannabis use (Eitle, Eitle, & Johnson-Jennings, 2013).

The Current Study

Building on the existing evidence of the importance of school-related promotive factors for American Indian youth,

this study extends the current knowledge base by using data from a prospective study of reservation-based American Indian middle school students to model the trajectories of school-related promotive factors over the course of ~1 year (three Waves). Two general hypotheses were tested. The first hypothesis was that significant average declines in each of the school-related promotive factors would be observed over the three Waves of data collection. The second hypothesis was that the school-related promotive factors (measured at Wave 2) would be predictive of less use of cannabis (measured at Wave 3), net of the control variables (measured at Wave 1).

Method

Sample

Data for this study came from the Our Youth, Our Future (OYOF) Study, an epidemiological survey research study of substance use, and related risk and protective factors, among American Indian (AI) middle and high school students. For the longitudinal study presented here, the OYOF sampling frame of schools was used to identify schools that: (1) included both grades 6 and 7; (2) were located either in the Northern Plains or the Southwest regions; (3) had enrollment of 70% or above AI students; and (4) had total enrollment for grades 6 and 7 of 125 students or above. Only 4 schools met these criteria in the Northern Plains while 8 schools met them in the Southwest. Two schools from each region were selected for initial recruitment, based on large enrollments of students in grades 6 and 7. One of the two schools in the Northern Plains agreed to participate in the study. However, neither Southwest school agreed to participate; therefore, a third school in the Southwest region was contacted and subsequently agreed to participate. Thus, two schools, one from the Northern Plains (adjacent to a reservation with 70% AI students) and one from the Southwest (on reservation with 100% AI students), participated in the study. Both schools were public middle schools with grade configuration 6–8 and had a Locale classification code of "town, remote" in the National Center for Educational Statistics database of schools. Specific identities of schools and tribes are confidential.

In order to ensure significant participation of students in the study, a local community member was hired in each community to obtain consent from parents of 6th and 7th grade students and to assist during each survey occasion. These local coordinators completed human subjects training prior to their work in the study. They then worked to obtain active consent from parents/guardians for their child to participate in the study and active assent from the students themselves. This work included in-person and telephone meetings with parents/guardians to explain the study and answer questions about study procedures. Parental consent and student assent were obtained for 55% (Northern Plains) and 80% (Southwest) of all 6th and 7th grade students enrolled at the start of the study. A total of 339 sixth and seventh grade students participated in the longitudinal study. Schools were compensated $4000 per year for the time and resources needed to survey consented students. In addition, each school received a comprehensive report of their survey findings after each survey occasion.

Participants

A subset of the total longitudinal sample of students ($n = 280$, including 108 students from the Northern Plains school and 172 from the Southwest school) provided data for the current study based on two inclusion criteria: students must have indicated they were AI on one or more survey occasions, and they must have completed the baseline survey. Retention was relatively high in both schools across the three measurement occasions. Of the 280 participants, 241 (86 from Northern Plains/155 from Southwest) completed all three surveys, 23 (15 from Northern Plains/8 from Southwest) completed two surveys, and 16 (7 from Northern Plains/9 from Southwest) completed one survey. The average age at the start of the study was 11.99 years (SD = 0.87) and 54% of participants were female. While all participants included in the current study sample indicated their race as AI, a number of participants also indicated their race was White ($n = 27$), Black or African American ($n = 13$), and/or another race ($n = 31$) at Wave 1. Likewise, 13 participants indicated their ethnicity as Hispanic/Latino at Wave 1. Table 1 presents descriptive statistics for demographic variables.

Procedures

For each participating school, school board approval was obtained. All procedures were also approved by the Institutional Review Board at Colorado State University. The community coordinator administered each survey to students during a normal classroom period via the Qualtrics online survey administration platform. The survey took an average of 50 min to complete. It consisted of items assessing students' substance use (including cigarettes, alcohol, and cannabis use), as well as relevant demographic, risk, and promotive factors. Students completed the survey once per semester over the course of three consecutive semesters, and individual student responses were anonymously linked across the three assessments via a unique alpha-numeric code assigned to each student. The Northern Plains school completed their first assessment in May 2018; their second in October 2018 and their third assessment in

Table 1 Descriptive statistics and correlation matrix of study variables

	Descriptive statistics			Correlation matrix																	
	n	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Control variables (Wave 1)																				
1. Northern Plains School	280	0.39	0.49	—																
2. Male sex	280	0.46	0.50	-0.06	—															
3. Lives with both biological parents	280	0.44	0.50	-0.06	0.03	—														
4. Age	278	11.99	0.87	0.32*	0.02	0.02	—													
5. Grade 6	280	0.54	0.50	-0.10	0.05	-0.02	-0.73*	—												
6. Any lifetime cannabis use	280	0.28	0.45	-0.24*	0.06	-0.10	0.16*	-0.24*	—											
School promotive factors (Wave 2)																				
7. Enjoys school	254	2.66	1.03	0.01	0.03	0.09	-0.05	0.06	-0.07	—										
8. Hates school (reverse coded)	254	2.17	1.08	0.10	0.09	0.00	-0.06	0.10	-0.06	0.29*	—									
9. Looks forward to school	254	2.70	1.01	0.07	0.01	-0.03	-0.07	0.08	-0.07	0.64*	0.18*	—								
10. Likelihood of high school graduation	254	3.58	0.79	0.05	-0.11	0.07	0.07	-0.03	-0.07	0.28*	-0.09	0.22*	—							
11. Likelihood of going to college	254	3.44	0.88	0.00	-0.16*	0.04	0.02	-0.04	-0.11	0.29*	-0.01	0.22*	0.78*	—						
12. Likelihood of graduating from college	254	3.32	0.95	0.01	-0.22*	0.09	0.07	-0.07	-0.13*	0.28*	0.01	0.23*	0.76*	0.87*	—					
13. Tries to do their best in school	254	3.24	0.90	0.04	0.00	-0.05	-0.08	0.07	-0.04	0.49*	-0.03	0.53*	0.39*	0.40*	0.39*	—				
14. Finds school work interesting	254	2.74	1.05	-0.06	0.11	0.11	-0.10	0.12*	-0.05	0.63*	0.14*	0.62*	0.28*	0.32*	0.31*	0.66*	—			
15. Grades in school	257	3.16	0.60	-0.13*	-0.14*	-0.02	-0.13*	0.15*	0.03	0.12	0.01	0.07	0.22*	0.26*	0.24*	0.24*	0.12	—		
16. Feels safe at school	254	2.67	1.07	0.06	0.02	0.03	0.03	0.05	-0.09	0.49*	0.16*	0.51*	0.28*	0.16*	0.21*	0.45*	0.51*	0.01	—	
17. Number of school activities	254	2.40	0.98	-0.18*	-0.07	0.09	-0.03	-0.01	0.05	0.10	0.04	0.13*	0.08	0.14*	0.17*	0.13*	0.17*	0.19*	0.10	—
Cannabis use outcome (Wave 3)																				
18. Past month cannabis use	246	0.85	1.37	-0.17*	0.00	0.04	0.17*	-0.23*	0.36*	-0.16*	-0.15*	-0.17*	-0.14*	-0.20*	-0.19*	-0.21*	-0.16*	-0.11	-0.07	-0.01

Wave 1 occurred during students 6th or 7th grade year. Wave 2 occurred ~6 months after Wave 1 and Wave 3 occurred ~6 months after Wave 2

*$p < 0.05$

April 2019. The Southwest school completed their first assessment in November 2018; their second in May 2019, and their third in November 2019. There was an average of 24 weeks (SD = 1 week) between Waves 1 and 2, and an average of 26 weeks (SD = 1 week) between Waves 2 and Wave 3.

Measures

School bonding

School bonding referred to the connection that students had to their schools and various aspects of their academic lives and consisted of three items from the Monitoring the Future Study (MTF; (Johnston et al., 2019)) measured on a 4-point Likert-type scale (1 = never to 4 = almost always). Items included: Thinking about the past year in school, how often did you: …enjoy being in school, …hate being in school, and …look forward to going to school. The second item was reverse coded. The mean of the items formed the score. Coefficient alpha = 0.74 at Wave 1, 0.63 at Wave 2, and 0.63 at Wave 3.

Academic aspirations

Academic aspirations referred to a student's belief that they would succeed academically, and its measurement consisted of three items measured on a 4-point Likert-type scale (1 = definitely won't to 4 = definitely will). Students were asked how likely they think it is that they will do each of the following things: graduate from high school, go to college, and graduate from college. The mean of the items formed the score. Coefficient alpha = 0.90 at Wave 1, 0.92 at Wave 2, and 0.91 at Wave 3.

Endeavoring in school

Students were asked how often, during the past school year, they tried to do their best in school. The item, taken from MTF (Johnston et al., 2019), was measured on a 4-point Likert-type scale (1 = never to 4 = almost always).

Interest in school

Students were asked how often, during the past school year, they found their schoolwork interesting. The item, taken from MTF (Johnston et al., 2019), was measured on a 4-point Likert-type scale (1 = never to 4 = almost always).

Grades in school

To measure grades students were asked: "What grades do you usually get in school?" (1 = mostly A's to 9 = mostly

F's). To put this item on a 1–4 range consistent with the other school-related promotive measures, the item was linearly re-scaled to range between 1 and 4 rather than 1 and 9, and reverse-coded so that a higher score signified better grades.

School safety

Students responded to a single item: "I feel safe at school" using a 4-point scale (1 = not at all to 4 = a lot).

Participation in school activities

Students indicated if they participated in a range of school-sponsored activities (including Native American Culture, Arts, and Language), where 0 = no and 1 = yes. Activities were identified based on the school websites, with additional input from school staff. The nine items were summed to create a count of activities. The variable was top-coded at 3, and a constant of one was added so that it's range would be equivalent to all other school-related promotive factors.

School bonding composite

As part of the sensitivity analyses, a composite measure of the seven school-related promotive factors just described was formed by taking the average of them. Coefficient alpha = 0.75 at Wave 1, 0.74 at Wave 2, and 0.77 at Wave 3.

Past 30-day use of cannabis

Cannabis use was measured with an item from MTF (Johnston et al., 2019). Students were asked: How many times (if any) have you used marijuana (weed, pot) or hashish (hash, hash oil) during the last 30 days? Response options were: 0 = 0 times, 1 = 1–2 times, 2 = 3–5 times, 3 = 6–9 times, 4 = 10–19 times, 5 = 20–39 times, and 6 = 40 or more times. As described in the analysis section below, a cumulative logit model was employed. Some of the response options were sparsely populated: $n(0) = 163$, $n(1) = 23$, $n(2) = 18$, $n(3) = 10$, $n(4) = 9$, $n(5) = 8$, $n(6) = 15$. Thus we collapsed categories 3 and 4 together and categories 5 and 6 together.

Control variables

A set of observed control variables that could confound the effects of interest (school-related promotive factors on cannabis use) or were important variables to covary were controlled in the fitted models. These included school membership (Northern Plains vs. Southwest school), sex, grade in school at the start of the study, a binary indicator of

living with both biological parents at Wave 1, and a binary indicator of whether or not the student reported having ever used cannabis at Wave 1.

Data Analysis

Analyses were conducted using R version 4.1.1 (R Core Team, 2020) and R Studio 1.4.1717 (RStudio Team, 2020). Data wrangling was performed using the tidyverse suite of packages (Wickham et al., 2019).

Descriptive statistics were computed, including means, standard deviations, n, and a correlation matrix. Table 1 presents descriptive statistics for all variables considered in the fitted models for Hypothesis 2 (described below).

To test Hypothesis 1, change in each school-related promotive factor across the three Waves of data collection was computed and plotted. In addition, an unconditional latent growth model was fit to each variable using a linear mixed effects model (specified in the lme4 package (Bates, Mächler, Bolker, & Walker, 2015) for R). The repeated measures of each school-related promotive factor were regressed on time (centered at the first Wave: Wave 1 = 0, Wave 2 = 1, Wave 3 = 2). A random effect was specified for both the intercept and slope for time, and these two random effects were specified to covary. For several of the outcomes, inclusion of a random slope produced a singular fit, and in these cases, the random slope was excluded. Missing data in the mixed effects model was handled via the maximum likelihood estimator.

To test Hypothesis 2, a series of cumulative logit models were fitted using the clm() function in the ordinal package (Christensen, 2019), one model for each school-related promotive factor was fit. A cumulative logit model is appropriate for an ordinal response variable. Use of cannabis (measured at Wave 3) was regressed on the school-related promotive factor (measured at Wave 2) and the control variables (measured at Wave 1). Age

and the school-related promotive factors were mean centered prior to estimating the model. Based on the fitted models, the ggeffects package (Lüdecke, 2018) was used to produce predicted probabilities of cannabis use at Wave 3 as a function of significant school-related promotive factors.

To handle missing data for Hypothesis 2, 30 multiple imputations of the data were produced using the mice package (van Buuren & Groothuis-Oudshoorn, 2011) for R. Scores on cannabis use and each of the school related promotive factors at each Wave were included in the missing data model, as were each of the control variables. Fitted models were estimated across the 30 imputed datasets, and then the results were combined using Rubin's rules (Rubin, 1976).

Results

Results for Hypothesis 1

Figure 1 presents change in the school-related promotive factors across the three Waves. The figure presents the raw means (and associated standard error of the mean) for each factor at Waves 1, 2 and 3. On average, school bonding, endeavor, interest, and school safety all demonstrated a marked decline over time, suggesting that these four promotive factors substantially waned in a monotonic fashion as students moved through middle school. Academic aspirations, grades, and activities changed less on average over the three Waves.

The results of the linear mixed effects growth models, presented in Table 2, corroborate the graphs. The fixed effect slope for school bonding, endeavor, interest, grades and school safety all suggest there was a significant linear decline over time. The effect for downward change in academic aspirations was marginally significant.

Fig. 1 Change in school-related promotive factors across middle school. Error bars represent standard error of the mean. Wave 1 occurred during students 6th or 7th grade year. Wave 2 occurred ~6 months after Wave 1 and Wave 3 occurred ~6 months after Wave 2
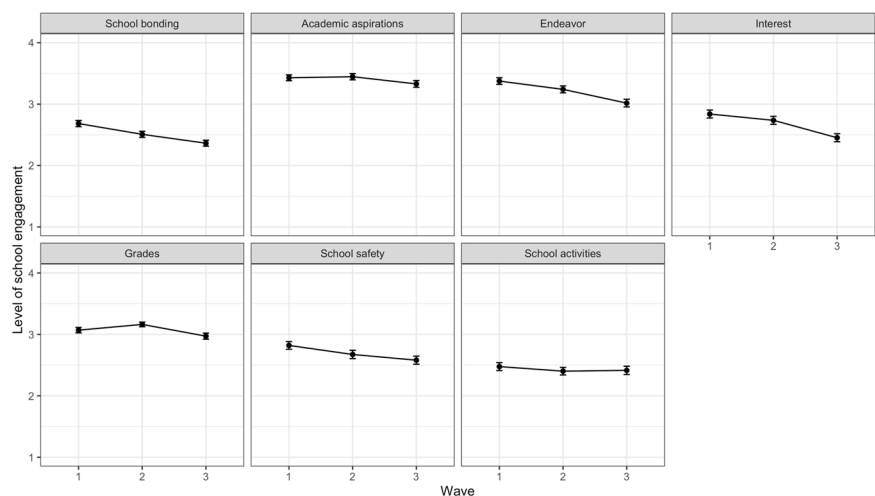
Table 2 Results of linear mixed effects growth models for change in school-related promotive factors from Wave 1 to Wave 3

	School bonding		Aspirations		Endeavor		Interest		Grades		School safety		School activities	
	Est	CI	Est	CI	Est	CI	Est	CI	Est	CI	Est	CI	Est	CI
Fixed effects														
Intercept	2.68	2.59, 2.77	3.45	3.35, 3.54	3.39	3.29, 3.49	2.87	2.76, 2.99	3.11	3.02, 3.19	2.81	2.69, 2.93	2.45	2.33, 2.57
Slope	−0.17	−0.22, −0.12	−0.05	−0.11, 0.00	−0.18	−0.25, −0.11	−0.21	−0.28, −0.13	−0.06	−0.10, −0.02	−0.13	−0.20, −0.05	−0.03	−0.11, 0.05
Random effects														
SD(Intercept)	0.61		0.55		0.49		0.66		0.56		0.63		0.72	
cor(Intercept, Slope)	−0.42		−0.19		−0.17								−0.55	
SD(Slope)	0.06		0.20		0.24								0.33	
SD(Residual)	0.52		0.58		0.74		0.81		0.46		0.82		0.79	

Wave 1 occurred during students 6th or 7th grade year. Wave 2 occurred ~6 months after Wave 1 and Wave 3 occurred ~6 months after Wave 2

Est Estimate, *CI* 95% confidence interval, *SD* standard deviation, *cor* correlation

Results for Hypothesis 2

Table 3 presents the results of the seven fitted models—one for each of the school-related promotive factors of interest. Adjusting for lifetime use of cannabis and the other control variables at Wave 1, several of the school-related promotive factors at Wave 2 were associated with the level of past 30-day cannabis use at Wave 3—including school bonding, aspirations, endeavor, and interest. No evidence of an effect was observed for grades, school activities and school safety. Figure 2 translates the four models that produced a significant effect of the school-related promotive factor to a graph of the model-fitted predicted probabilities of cannabis use.

Sensitivity Analysis

Several steps were taken to study the robustness of the effects reported in this study. First, the proportional odds assumption for the cumulative logit model was tested. This assumption dictates that a predictor exerts the same effect on each cumulative logit of the modeled outcome. This was tested using the nominal_test() function in the ordinal package (Christensen, 2019). No evidence of assumption violation was noted for any of the school-related promotive factors (all p values > 0.05).

Second, as described in the Measures section, some categories of the outcome (i.e., cannabis use at Wave 3) were collapsed given sparseness. To determine if this collapsing might have affected the results, the models for Hypothesis 2 were refit with the original variable. The pattern of results presented in this manuscript remained unchanged, indicating robustness to this analytic decision.

Last, the test of Hypothesis 2 involved including each school-related promotive factor in a separate model, but the combined effect of the school-related promotive factors may also be of interest. Inclusion of all of the school-related promotive variables as separate variables in a single model is tenuous given the correlation of these promotive factors and the small sample size. Instead, a composite variable that averaged the seven school-related promotive factors at Wave 2 into a single index was formulated and then included as a predictor in an eighth cumulative logit model to predict cannabis use at Wave 3 (using the same specification of the models presented in Table 3). The composite index was significantly associated with less cannabis use at Wave 3 ($b = -0.73$, 95% CI -1.23, -0.24).

Discussion

American Indian youth living on or near reservations start using cannabis at substantially younger ages, and continue

Table 3 Results of cumulative logit models to predict cannabis use at Wave 3

	School bonding		Aspirations		Endeavor		Interest		Grades		School safety		School activities	
	Est	CI	Est	CI	Est	CI	Est	CI	Est	CI	Est	CI	Est	CI
Intercepts														
0 times|1–2 times	0.57	−0.09, 1.23	0.42	−0.24, 1.08	0.50	−0.16, 1.16	0.58	−0.09, 1.24	0.51	−0.15, 1.16	0.52	−0.14, 1.17	0.51	−0.14, 1.17
1–2 times|3–5 times	1.11	0.43, 1.79	0.97	0.29, 1.64	1.04	0.37, 1.71	1.12	0.44, 1.80	1.04	0.37, 1.70	1.05	0.38, 1.72	1.04	0.38, 1.71
3–5 times|6–19 times	1.64	0.94, 2.34	1.51	0.81, 2.21	1.58	0.88, 2.28	1.65	0.94, 2.36	1.56	0.87, 2.25	1.57	0.88, 2.26	1.57	0.88, 2.26
6–19 times|20 or more times	2.49	1.72, 3.27	2.36	1.59, 3.13	2.43	1.66, 3.20	2.49	1.72, 3.27	2.40	1.64, 3.15	2.40	1.64, 3.16	2.40	1.64, 3.16
Regression slopes														
Northern Plains School	−0.50	−1.16, 0.17	−0.59	−1.24, 0.07	−0.52	−1.18, 0.13	−0.61	−1.27, 0.04	−0.62	−1.28, 0.03	−0.57	−1.22, 0.08	−0.60	−1.26, 0.05
Male sex	−0.09	−0.64, 0.46	−0.30	−0.86, 0.27	−0.18	−0.74, 0.37	−0.10	−0.65, 0.46	−0.22	−0.79, 0.34	−0.16	−0.71, 0.39	−0.17	−0.72, 0.39
Lives with both biological parents at Wave 1	0.12	−0.43, 0.68	0.14	−0.41, 0.70	0.08	−0.48, 0.64	0.17	−0.39, 0.73	0.12	−0.43, 0.68	0.12	−0.43, 0.67	0.14	−0.41, 0.69
Age at Wave 1	0.14	−0.36, 0.64	0.22	−0.27, 0.72	0.15	−0.35, 0.65	0.19	−0.31, 0.69	0.20	−0.29, 0.69	0.21	−0.29, 0.71	0.19	−0.30, 0.68
Grade 6 at Wave 1	−0.62	−1.43, 0.18	−0.63	−1.44, 0.19	−0.62	−1.43, 0.19	−0.56	−1.36, 0.24	−0.53	−1.33, 0.26	−0.57	−1.37, 0.23	−0.59	−1.38, 0.21
Lifetime use of cannabis at Wave 1	1.33	0.74, 1.93	1.25	0.66, 1.84	1.35	0.76, 1.94	1.31	0.72, 1.90	1.37	0.78, 1.97	1.33	0.74, 1.92	1.36	0.77, 1.95
School promotive factor at Wave 2	−0.45	−0.81, −0.10	−0.42	−0.73, −0.11	−0.39	−0.68, −0.10	−0.33	−0.60, −0.07	−0.31	−0.79, 0.17	−0.12	−0.38, 0.15	−0.10	−0.38, 0.19

Estimated coefficients are in the metric of log odds. Wave 1 occurred during students 6th or 7th grade year. Wave 2 occurred ~6 months after Wave 1 and Wave 3 occurred ~6 months after Wave 2

*Est* Estimate, *CI* 95% confidence interval

to use at much greater rates, than the general child and adolescent population (Stanley & Swaim, 2015; Swaim & Stanley, 2018). The decades-long persistence in these disparities underscores an urgent need to identify robust and modifiable promotive factors targeting both early initiation and escalation of American Indian cannabis use over time. This study focused on school engagement. Results indicate that many of the school-related promotive factors waned over the course of middle school, and that several indicators of school engagement were predictive of less subsequent cannabis use among American Indian middle school students. Thus school engagement should be considered as a potentially important promotive factor for prevention of cannabis use among American Indian adolescents.

The present longitudinal study, conducted over 1 year during American Indian students' 6th and 7th grade years, provides important evidence that school-related promotive factors tend to wane over time, a phenomenon that is consistent with what is observed in the general population of adolescents (Lam et al., 2014; Wang & Eccles, 2012). In addition, findings from this study indicate that several school-related promotive factors are predictive of the level of subsequent past 30-day cannabis use among American Indian middle school students. When considering the school-related promotive factors at Wave 2, American Indian youth reporting greater school bonding, academic aspirations, proclivity to endeavor in their studies, and interest in school reported less cannabis use at Wave 3, controlling for lifetime prevalence of use at Wave 1 and several additional control variables.

Although it was hypothesized that each of the school-related promotive factors would be predictive of subsequent past 30-day cannabis use, we did not find evidence of this for several factors—including academic grades, perception of school safety, and participation in school activities. A non-significant statistical effect for these variables should not be taken as a determination that they are inconsequential. Indeed, it could be that these variables were not well-measured—a point that may be particularly salient given grades and safety were measured with a single item. Additional work to determine their importance is necessary.

In general, the significant findings for school bonding, endeavoring to achieve, interest in school work, and academic aspirations are consistent with social control theory (Gottfredson & Hirschi, 2019) and social developmental models of adolescent substance use (Cambron, Catalano, & Hawkins, 2018) which posit that young people who demonstrate early commitment and interest in school, and who aspire to greater academic achievements, are less inclined to engage in problematic or delinquent behaviors (Payne & Salotti, 2007). Similarly, these findings suggest American Indian youth who report high levels of these school-related promotive factors may be engaging in

Fig. 2 Predicted probability of cannabis use as a function of school-related promotive factors (estimated from Table 3 models)
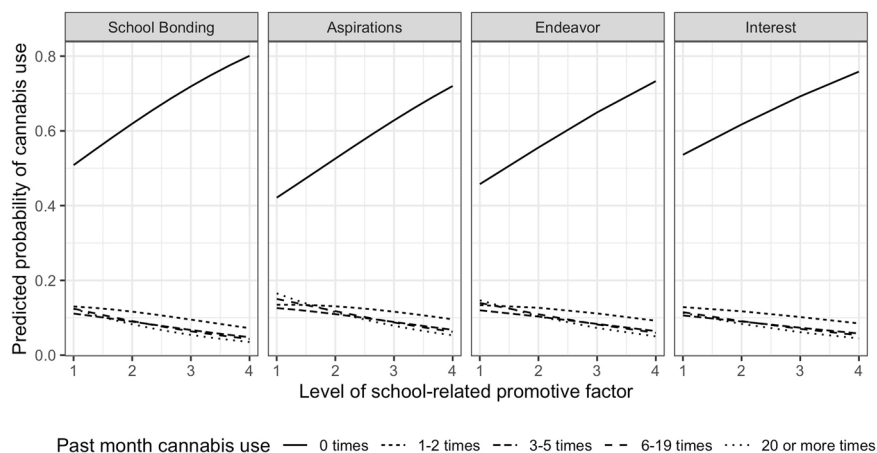
thoughtfully reflective decision-making, leading them to avoid or mitigate cannabis use to maintain a trajectory consistent with their goals (Paternoster & Pogarsky, 2009).

The four school-related promotive factors found to predict subsequent cannabis use in this study—school bonding, endeavoring to achieve, interest in school work, and academic aspirations—may be conceptualized as key components of Eccles' (2009) expectancy-value theory. In her framework, students' decision-making process for school behavior is thought to be driven by their expectancies for academic success and the perceived value of academic tasks (e.g., learning) and academic outcomes (e.g., going to college). Subjective task values include interest in school work, value of working hard to achieve success, and value of attained outcomes and future goals (e.g., achievement, accumulated education) (Wang & Hofkens, 2020). Moreover, a similar process may exist for the social aspects of the school environment (Wang & Hofkens, 2020). That is, that motivation to engage in school may also be driven by an affinity for the school context (i.e., school bonding). To the extent that the four variables found to be important in the present study pertain to critical elements of expectancy-value theory, then a rationale is found for the emergence of these particular variables (i.e., holding high aspirations for academic success, endeavoring to do well in school, finding interest in school work, and feeling a bond to school).

Synthesizing the results, these findings are broadly consistent with existing prospective studies examining the promotive role of school engagement (and related variables) in reducing cannabis use among non-American Indian child and adolescent samples (Bryant, Schulenberg, O'Malley, Bachman, & Johnston, 2003; Henry, Knight, & Thornberry, 2012; Henry, Smith, & Caldwell, 2007; Li & Lerner, 2011). Though the findings reported here cannot be interpreted as causal effects, they do provide some promise for the potential importance of school-related promotive factors in preventing cannabis use among American Indian middle school students. The results suggest that further work to

examine these factors as potential causal agents is warranted.

Implications for Prevention

A focus on school-related promotive factors is advantageous as they are both malleable and represent a strengths-based approach to prevention. The results presented in this study demonstrate a clear deterioration of many of the school-related promotive factors over just this one year. Development, evaluation, and implementation of interventions that can prevent this disengagement process is critical. It is likely that a multi-pronged approach is necessary, one that aims to build the capacity of the school, the family, and the child to develop and maintain engagement in school. Wang and Eccles (2012) offer important advice on the timing and targets of intervention to keep young people engaged in school. They point out that adolescents need to feel a sense of belonging, competence, autonomy, and efficacy. Yet many school environments do not offer a setting for these needs to be met. Promoting school environments that are better equipped to offer these developmental needs is likely a key path to improved school engagement for American Indian students.

These findings point to the importance of bolstering levels of school engagement among reservation-based American Indian youth as early as possible, particularly as school engagement appears to naturally wane over time. Indeed, early interventions specifically designed to target pro-social, agentic positive action among elementary-school aged youth may be particularly effective for American Indian students entering middle-school. For example, the Positive Action (PA) program has demonstrated robust improvements in factors relevant to school engagement, and reduced incidence of delinquent or harmful behaviors (Snyder et al., 2013). Cultural adaptation, implementation, and evaluation of programs such as these in American Indian schools is recommended.

Future Directions

The findings reported in the study point to potentially productive areas of future research that may provide an important avenue for reducing the high rates of substance use among reservation-dwelling American Indians. The study results suggest that maintaining (and increasing) school engagement in middle school and beyond may provide one path for reducing rates of cannabis and other substance use initiation. However, further research is needed to verify and more fully understand the relationships between school-related promotive factors and substance use for this population, especially given the lack of research in this area. This investigation capitalized on one study of American Indian middle school adolescents, and used the existing school engagement measures to test hypotheses. However, a future study that is specifically developed to measure school engagement among American Indian adolescents is clearly needed.

In addition, research to develop and test school-based interventions to promote school engagement among American Indian children and adolescents is needed. For example, in a study of Native American middle school youth, development of positive self-relevant academic representations enhanced feelings of belonging in the classroom (Covarrubias & Fryberg, 2015). More research of this type must be conducted in order to identify the steps that schools can take to improve youth outcomes. American Indian communities have exhibited great resilience in response to harsh adverse experiences and structural barriers to success, such as historical trauma and discrimination, due to the assets and resources within their communities. Schools can serve as one of these key assets. Identifying barriers to school engagement specific to American Indian youth living on reservations and developing strategies to overcome these barriers should be critical areas of research.

Wang and Hofkens (2020) lay out several unique frameworks for considering how academic engagement and social engagement, two critical elements of school engagement for students, work together to promote academic success—including additive effects (each type of engagement is important), moderating effects (e.g., the beneficial effects of academic engagement depend on social engagement), and reciprocal effects (a feedback loop where academic and social engagement perpetuate one another). Although their framework does not consider substance use directly, future work to build on the Wang and Hofkens model to incorporate positive youth development in other arenas (including avoidance of cannabis and other substance use) may prove fruitful.

Limitations

Though the current study findings provide some novel prospective evidence for an association between school-related promotive factors and a more favorable course of cannabis use onset and escalation during early adolescence among American Indian youth, the results should be considered in light of several important limitations. First, participants were not fully representative of all reservation-based American Indian 6th and 7th graders, nor were the participating American Indian schools representative of all middle schools enrolling reservation-based American Indian youth. However, these data do represent two reservations located in the Southwest and Northern Plains regions of the United States, where ~60% of all reservation-based American Indians reside based on US 2010 Census data. Second, the estimated beneficial effects of school-related promotive factors cannot be assumed to be causal. Though the prospective design is an advantage in this case, the lack of access to a broad array of potential confounders precluded the testing of causal pathways. Third, seven school-related promotive factors were considered in this paper, but there are others that were not measured in the study—for example, bonding to teachers, attendance, official records of achievement. In addition, the measures were not derived from current theories of school engagement. Fourth, this study relied on self-report of all measures, and therefore undoubtedly suffered from reporting bias, social desirability bias, and common method bias.

Conclusion

Little work has examined school engagement as a promotive factor against cannabis use among American Indian adolescents. Insight is offered into how school-related promotive factors change over the course of middle school for American Indian adolescents, demonstrating a clear trend of deterioration for many of the factors. Additionally, several school-related promotive factors were found to predict less frequent cannabis use approximately six months later. The study findings build on numerous theories of adolescent pro-social development. Moreover, these findings suggest a need to develop programs, practices and policies that can help American Indian adolescents maintain strong engagement throughout middle school, and then test these initiatives to determine if promotion of school engagement can prevent onset and escalation of cannabis use. Each of the school-related promotive factors examined in this study are malleable, and efforts to promote school engagement and the school experience for American Indian children constitutes a strengths-based approach to substance use prevention.

conducted preliminary analysis, drafted substantial sections of the paper, and provided critical revisions. R.C.S. served as principal investigator of the parent project, including funding acquisition; he also contributed to the literature review, drafted substantial sections, and provided critical revisions. L.R.S. served as principal investigator of the parent project, including funding acquisition; she also contributed preliminary analysis, drafted substantial sections, and provided critical revisions. All authors read and approved the final paper and agree to be accountable for all aspects of the work.

Data Sharing and Declaration The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

Ethical Approval All aspects of the project were performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments. Current study protocols and procedures were reviewed and approved by the Colorado State University Institutional Review Board.

Informed Consent Informed assent/consent was obtained from all individual participants and their parents or legal guardians.

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