A study on the association between educational attainment and substance use disorder from ages 33 to 47, and the moderating role of perceived neighborhood social cohesion.

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Abstract

A study on the association between educational attainment and substance use disorder from ages 33 to 47, and the moderating role of perceived neighborhood social cohesion.

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Purpose: Examine the association between educational attainment at age 27 and later substance use disorder (SUD), and if the hypothesized association is modified by perceived neighborhood social cohesion assessed at age 27.

Methods: This study used data from the Seattle Social Development Project (SSDP), a prospective cohort study that recruited 5th graders in 1985 [N = 808] from 18 elementary schools in lower income neighborhoods in Seattle. The study collected data via interviews conducted from 5th grade through age 47. Participants were asked at age 30 about their educational attainment at age 27. A binary variable was created to reflect if the participant completed at least a 4-year college degree or not [0 = completed at least a 4-year college degree or more, 1 = completing less than 4-year college degree]. Participants were administered relevant SUD modules from the Diagnostic Interview Schedule to determine if they met DSM-IV criteria in the past year for abuse, dependence, or both for alcohol, cannabis, and other drugs. A binary variable was created to reflect if the participant met criteria for abuse and dependence (SUD) for any of

those substances at any time at ages 33, 39, and 47 [1 = met SUD criteria at least once for at least once substance based on interviews from age 33, 39, and 47, 0 = did not met SUD criteria based on interviews at age 30, 33, 39, and 47]. Perceived neighborhood social cohesion was measured at age 27 using a subscale of the Collective Efficacy measure created by Sampson and Raudenbush. A dichotomous variable was created to indicate low vs. high perceived neighborhood social cohesion. Poisson regression was used to estimate prevalence ratios for the association between educational attainment and SUD. To assess effect modification, analyses were stratified by high and low perceived neighborhood social cohesion.

Results: Participants missing data on the exposure or covariates were excluded, resulting in a final analytic sample size of 613 participants. Among this sample, about 75% of participants completed less than a 4-year college degree and about 30% of the total participants met criteria for SUD. Individuals with less than a 4-year college degree had 1.17 times (95% CI: 0.84, 1.65) higher prevalence of later SUD compared to individuals with college education or more after adjusting for previous substance use assessed at age 18, sex, and race and ethnicity. After stratifying by low (PR = 1.23, 95% CI: 0.72, 2.08) and high social cohesion (PR = 1.17, 95% CI: 0.75, 1.83), the prevalence ratios were slightly different.

Conclusions: The study did not find evidence for an association between low educational attainment and SUD from ages 33 to 47 after adjusting for previous history of substance use, race and ethnicity, and sex. The results of the stratification analysis suggest that neighborhood social cohesion is not an effect modifier in the relationship between educational attainment and SUD from ages 33 to 47. Future research should continue to examine the role of neighborhood factors as a buffer against low SES to expand opportunities for interventions.

Introduction

The US National Survey on Drug Use and Health (NSDUH) estimated that in 2023, approximately 16.7% of individuals aged 12 or older in the United States, about 48.5 million people, met criteria for a substance use disorder (SUD) in the past year.[1] This is over a two-fold increase from 2014 NSDUH estimates.[2] The most common SUDs involve alcohol or cannabis, with 10.5% of the population meeting criteria for alcohol use disorder and 6.7% of the population meeting criteria for past-year cannabis use disorder.[3] SUD is often characterized by the inability to stop using substance(s) despite significant negative consequences in several domains in life. Symptoms according to the DSM-V include lack of control over substance use, cravings, using in dangerous situations and/or consuming dangerous amounts of the substance, building a tolerance to the substance, and showing signs and symptoms of withdrawal.[4] Risk factors for SUD in adulthood include early initiation of substance use in adolescence and family history of substance use.[5,6]

Existing research demonstrates a link between socioeconomic status (SES) and health, with those with lower SES often having worse health outcomes.[7,8] Educational attainment is often used as a measure of SES because it is a proxy for accumulated privileges.[9] Cutler and Llernas-Muney found that people with higher education were less likely to report hypertension, emphysema, diabetes, and other chronic conditions.[10] People with higher education were also less likely to die prematurely.[11] Individuals who have graduated from a 4-year college had better physical health compared to those who did not obtain a bachelor's degree from a 4-year college.[11]

Cutler and Lleras-Muney proposed theories on the potential impacts of education on health, including that more education increases access to resources such as healthcare. Higher

education may also open doors to higher paying jobs that not only increase access to resources, but also safer work environments, and that those with higher education are more likely to trust science and implement suggestions from health education. They also theorize that individuals with higher education have better access to resources that allow them to better cope with stressors, instead of turning to substances.[10]

Some studies have also found a link between education and risk of SUDs; however, findings have been inconsistent, prompting the need for more research into the area.[12–17] For example, multiple studies found a relationship between lower educational attainment and higher likelihood of substance use or substance use disorder.[13–17] Notably, some of these studies were cross-sectional, making those studies unable to establish temporality due to the exposure and outcome being assessed at the same time. Other studies, however, have found an association between higher education and increased substance use.[18,19] In a study done by Moore et al. looking at alcohol consumption, they found that alcohol consumption was greater in those with higher education.[19] Ford et al. also found that prevalence of any past-year prescription drug misuse was greater in individuals, aged 18 to 25, who went to college compared to those who dropped out. The authors did not specify which type of college. They also found that those who graduated high school were at higher risk for prescription drug misuse compared to those who dropped out of high school.[18] The general trends point to a relationship between lower educational attainment and higher likelihood of substance use.

There are further issues to address when considering in the relationship between educational attainment and SUD. Many focus generally on substance use frequency[13,16,18,19] or drug overdoses[12,14,15,17], rather than SUD as the outcome. SUD is a particularly impairing form of substance use, associated with a lot of consequences. There could also be differences in

associations when looking at SUD as an outcome compared to simply substance use or substance use frequency. An example of this could be alcohol. Drinking is engrained into many cultures, and it may be possible for an individual to drink relatively frequently without causing negative consequences in other domains of their life. Thus, an individual could be drinking alcohol at what could be considered a high frequency but still not meet criteria for alcohol use disorder (AUD).

There is limited research in understanding the role of educational attainment in SUD in adulthood. Within this limited research, many of the studies look at how educational attainment and school behaviors in youth and adolescence affect substance use outcomes in adulthood.[20,21] This study will focus on educational attainment in adulthood and how that affects SUD in adulthood. It is important to understand this association across all age groups to better target future interventions. If there is an age group with a particularly strong positive association with SUD, it might be worth investing more into interventions that target that age group.

Studies suggested that various neighborhood factors (e.g., disadvantage, affluence, residential stability) are associated with SUD. [13,22–24] One neighborhood characteristic that that has been linked to better health outcomes, such as lower risk of cardiovascular events, stroke, and mortality,[25] is social cohesion. Social cohesion is often defined as the degree to which residents feel they belong in the area and the degree of trust that is shared among neighbors.[25] There may be a relationship between social cohesion and substance use. Researchers in the Netherlands found there was higher level of hazardous alcohol use in neighborhoods with low neighborhood social cohesion compared to neighborhoods with moderate social cohesion.[23]

Karriker-Jaffe theorized that neighborhoods with more disadvantage may lack social and material resources that could help buffer against the effect of individual stressors on residents

and as a result, residents of disadvantaged neighborhoods may be more likely to use substances to cope with stress. There is limited research on the protective effect of neighborhood factors against the impacts of low SES. In a study done by Williams and Latkin, the researchers found that social networks and employment were protective against current drug use among adults in Baltimore City.[26] Another study from the United Kingdom looked at the association between low SES and neurodegeneration and if low neighborhood deprivation buffers that association. The study found that although there was a link between lower SES and more signs of neurodegeneration, this association was less prominent among individuals living in neighborhoods with less deprivation.[27] Building off Karriker-Jaffe's theory, neighborhood social cohesion could be a resource that residents use to buffer against the effect of individual stressors. Low educational attainment could also be a proxy for an individual's experience with stressors.

Using data from a prospective cohort study, **Aim 1** of the study examines the association between educational attainment at age 27 and likelihood of meeting criteria for a SUD from ages 30 to 47. **Aim 2** of the study examines if the hypothesized association is moderated by perceived neighborhood social cohesion age at 27. This study will give further insight into the role of educational attainment in risk of SUD and potential protective effects of neighborhood social cohesion. We hypothesized that there would be a negative association between educational attainment and later SUD. We also hypothesized that perceptions of neighborhood social cohesion would moderate the effects of low educational attainment on future SUD such that the association between lower education and SUD would be stronger among those with lower perceived neighborhood social cohesion compared to those with higher perceived neighborhood social cohesion.

Research on the impacts of different socioeconomic indicators and substance use outcomes is needed to promote health equity and gain more insight on how and where to target interventions. The results of this study may have important implications for identifying high risk populations and prevention strategies to mitigate impacts of not completing a 4-year college degree on SUD.

Methods

Study Design and Data Source

Data for this study were from the Seattle Social Development Project (SSDP), a prospective cohort study. The study recruited a cohort of 5th graders in 1985 from 18 elementary schools in lower income neighborhoods in Seattle. The study followed the cohort over time, interviewing them at various timepoints of their lives. Specifically for this study, data was collected at ages 27, 33, 39, and 47. Data collection was done through interviews with a trained member of the study team. The study was approved by the Human Subjects Review Committee at the University of Washington. All participants gave informed consent before data collection continued.

Study Population

To be eligible for the SSDP study, participants must have been in 5th grade in 1985 and from the specific 18 Seattle elementary schools in lower income neighborhoods. The project initially recruited 808 participants out of the 1053 eligible.

Measures

Educational Attainment

Educational attainment was assessed by asking participants at age 30 about their highest level of education completed at age 27. Besides traditional schooling, the questionnaire also

included responses for vocational and other professional degrees. This variable was recoded as a binary variable (0 = 4-year college degree, 1 = completing less than a 4-year college degree, including GED, technical, vocational school, and/or a 2 year college degree).

SUD

To determine if participants met criteria for SUD, they were administered the Diagnostic Interview Schedule at each wave of data collection starting from age 21. For this analysis, information from ages 33, 39, and 47 were used. An algorithm was used to determine if the participant met DSM-IV criteria for abuse, dependence, or both for alcohol, cannabis, and other substances. A new binary variable was created that indicated whether the participant met criteria for abuse and dependence at any study wave for any of the substances (0 = did not meet criteria at any point, 1 = met criteria for SUD at least once for at least one substance). If a participant was missing an assessment, but met criteria at least once across the 3 waves, their response was recoded as meeting SUD criteria. Any participant who did not meet criteria at any point but had a missing value at one survey wave was recoded as never meeting criteria for SUD.

Perceived neighborhood social cohesion

The neighborhood social cohesion subscale of the Collective Efficacy measure developed by Sampson and Raudenbush was used at age 27 to determine individual perceptions of neighborhood social cohesion.[28] The study scale asked participants how much they agreed or disagreed with five statements such as, “People around here are willing to help their neighbors” and “This is a close-knit neighborhood.” Response options were Strongly Agree (0), Somewhat Agree (1), Somewhat Disagree (2), and Strongly Disagree (3). The scores were summed for a possible range of 0 to 15, with a *lower* score indicating higher perceptions of neighborhood

social cohesion. The median was used as a cut off value to create a dichotomous variable for low (8-15) vs high (0-7) social cohesion.

Race and Ethnicity

Participants at age 27 were asked, “What do you consider your ethnic or racial group to be?” and were given response choices of “White, Black or African American, Asian, Hispanic or Latino, Native American or Alaka Native, and Native Hawaiian or Pacific Islander” and asked which group they identified themselves as. Participants missing race and ethnicity data were dropped from the dataset. Race and ethnicity are included as confounders because it is a proxy for the experiences of all forms of institutional, interpersonal, and structural racism,[29] and the effect that it has on health outcomes, specifically SUD.[30,31] Structural racism also plays a role in educational attainment, leading to disparities in educational attainment across racial and ethnic identities.[32–34]

Sex

Participant sex was recorded and coded as a binary variable [0 = male, 1 = female].

Previous Substance Use

At age 18, participants were asked if they had ever used a variety of substances, such as alcohol, cannabis, cocaine (including crack), amphetamines, tranquillizers, sedatives, psychedelics, and narcotics. If they answered yes to any, they were asked about the frequency of their use in the past year. Participants who responded yes to drinking were asked how many drinks they had on the days they drank. A binge drinking variable was then created based on respondent sex (5 or more drinks for men or 4 or more drinks for women on the same occasion).[35] A variable was then created to describe if the participant met criteria for binge drinking or reported using one or more of the other substances listed [0 = no past year binge

drinking and never reported using a substance, 1 = any past year binge drinking criteria and/or reported lifetime use of other substances]. This variable will be used as an adjustment variable for previous substance use, as previous research has found it as a risk factor for future SUD. [36] For this variable, binge drinking was used instead of any alcohol use because it better identifies excessive use and shows stronger associations with later problematic alcohol use compared to any drinking.[37] Age 18 was chosen because it may capture substance use before individuals often enter college and, thus, would assist with establishing temporal precedence.

Analysis

Participants missing data for educational attainments or other covariates were removed from analyses and the remaining study sample included 613 individuals. Poisson regression with robust standard errors was used to estimate prevalence ratios. Prevalence ratios were picked over odds ratios because, due to the outcome not being rare (<10% of the sample), the interpretation of an odds ratio is not as straightforward to interpret. For aim 1, an unadjusted model was run to compare with the adjusted model.

For aim 2, stratification analyses were performed to examine the potential effect modification role by neighborhood social cohesion. The sample was stratified by perceptions of high vs. low neighborhood social cohesion.

Results

The demographics of the study sample are described in Table 1. Various racial and ethnic groups were represented in the sample: 43% were White, 21% Black or African American, 13% Asian, 12% Indigenous, 6.8% Native Hawaiian or Pacific Islander, and 4.6% Hispanic or Latino. About 25% (n = 156) completed a 4-year college degree or more. When looking by completing a 4-year college degree, those who completed a 4-year college were more likely to be White and

Asian, compared to those were more likely to **not** complete a 4-year college. The population was almost evenly split among male and female participants, with slightly more female participants. Educational attainment was also almost evenly split between male and female respondents. About 47% of the sample reported past year binge drinking or lifetime use of cannabis, cocaine (including crack), amphetamines, tranquillizers, sedatives, psychedelics, or narcotics at age 18. Among those who reported past year binge drinking of lifetime use of the substances, about 63.1% did not complete a 4-year college degree. On the 0 to 15 scale for perceived neighborhood social cohesion, scores ranged from 0 to 13, with the median score being 7. Among the participants, about 30% (n = 181) met SUD criteria at one of the study waves between age 30 and 47. A greater percentage of individuals **without** a 4-year college degree met SUD criteria (32%, n = 148) compared to those who completed a 4-year college degree or more (21%, n = 33). Alcohol appeared to be the most common substance that participants met SUD criteria for with about 23% (n=144) of the total sample meeting criteria for alcohol use disorder (AUD). This trend remained consistent after breaking down SUD type by educational attainment. Further, 110 individuals (17.9%) met SUD criteria for more than one substance.

The results from the regression analyses are displayed in Table 2. The unadjusted prevalence ratio for the association between educational attainment and later SUD was 1.53 (95% CI: 1.20, 2.13). After adjusting for race and ethnicity, sex, and previous substance use, the association was attenuated and no longer statistically significant (PR: 1.17; 95% CI: 0.84, 1.65; p-value = 0.36). Post-hoc analyses were done further understand the role of previous substance use on educational attainment. When solely adjusting for the confounders sex and race and ethnicity, the prevalence ratio was 1.27 (95% CI: 0.91, 1.77). However, when including previous

history of substance use in the model, the prevalence ratio then became 1.17 (95% CI: 0.84, 1.65).

Results from the stratification analyses are shown in Table 3. After stratifying by social cohesion, the prevalence ratio was 1.23 (95% CI: 0.72, 2.08) among those with low social cohesion; and among those with high social cohesion, the prevalence ratio was 1.17 (95% CI: 0.75, 1.83).

Discussion

In this longitudinal study that followed individuals from 5th grade though age 47, we examined the association between completing a 4-year college degree and SUD from ages 33 to 47 and if the association varies by perceived neighborhood social cohesion. The study failed to indicate an association between 4-year college completion and of SUD from ages 33 to 47. Further analyses found that the association did not vary by perceived neighborhood social cohesion.

It was surprising to find that the study did not provide evidence for an association between 4-year college completion and SUD from ages 33 to 47, given that many existing studies have found a relationship between lower educational attainment and substance use, specifically SUD.[12–17] There may be several reasons for our findings. One being that 24.1% of the original participants were removed from the data set due to missing data. These individuals contribute important data that could give a clearer understanding of the association. It would be interesting to see if the association changes using different operations of educational attainment. Oh et al. conducted a longitudinal cohort study that examined the potential effects of participation in a government-sponsored program that focused on vocational training. The results showed that those who were in the program were less likely to binge drink, use cannabis, and

illicit substances compared to those who did not participate in the program.[38] It could also be interesting to see if the association changes when breaking SUD down by types of substances. In a study done by Ford et al., the researchers found that the relationship between educational attainment and prescription drug misuse changed when broken down by type of prescription drug.[18] Participants who continued on to college were at higher risk for frequent stimulant misuse, while those who dropped out of high school were at increased risk for frequent sedative/tranquilizer misuse and frequent opioid misuse when compared to the group who continued on to college.

Adjusting for previous substance use is important, because existing studies have found that substance use in youth and adolescence not only increases risk of future substance use[36,39], but can also hinder future educational attainment. In a study done by Fleming et al., researchers had found that those who dropped out of high school were more likely to have used cannabis at age 18 when compared to those who went to a 2-year college or 4-year college.[40] In our study, it was notable from post-hoc analyses that the association between educational attainment and SUD from ages 33 to 47 further decreased after adjusting for previous substance use at age 18. It will be important to continue to study the interplay between substance use and education, and other domains that affect long-term outcomes.

Although it was hypothesized that perceived neighborhood social cohesion would buffer the association between low educational attainment and SUD from ages 33 to 47, it was not the case in this study. When stratifying by high and low perceptions of neighborhood social cohesion, the estimates of association between education and SUD were similar. This was surprising as previous studies have theorized and found that social cohesion may play a protective role against effects of low SES.[41–43] For future studies, it could be interesting to break

down perceptions of neighborhood social cohesion into 3 categories, similar to the work of Kuipers et al. The researchers in that study divided perceptions social cohesion into low, moderate, and high and found that there were no differences between the low and high groups, but there may be some effect moderation present in the moderate versus low groups.[23] It would be interesting to see if this result would be replicated using this study sample. It would also be interesting to see if effect modification is present when looking at SUD by specific substances. This could give some insight into if higher perceptions of neighborhood social cohesion are more protective against certain substances in those with less than a 4-year college degree.

This study has notable limitations. A limitation was the reduction from 808 participants to 613 participants due to missing data for educational attainment, race and ethnicity, and previous history of substance use. A reduction in the sample size due to missing data can also lower statistical power to detect significant results and introduce bias. Another limitation of this study is the potential for misclassification of several variables in the study. There is potential misdiagnosis for SUD because it is determined if an individual meets criterion for SUD through a fully scripted interview rather than a clinical diagnosis. Another limitation is that given that some of the questions are asked over the lifetime, the past year, etc., respondents may not accurately be able to recall all the details accurately in such a large time frame. Given that the study sample was recruited from low income areas in Seattle, study findings may not be generalizable to the broader population.

Although there are some limitations, there are several strengths to this study. This study is one of the few studies that examines SUD as an outcome for substance use when using educational attainment as an exposure. This study also was able to assess SUD into midlife. Another benefit of the study is that it uses data from a longitudinal study, allowing for the

possibility of establishing temporality. It will also contribute to the growing literature looking at social cohesion, a neighborhood characteristic that has been linked with better health outcomes.

This study did not find evidence for an association between low educational attainment and SUD from ages 33 to 47. Perceptions of neighborhood social cohesion also did not appear to be an effect modifier in the association. It would be interesting to see how the results change after performing imputation to address the missing data problem. Future research should continue to examine the potential role of neighborhood factors as a buffer between low SES and future likelihood of SUD, as it can further our knowledge and expand opportunities for interventions.

Table 1. Characteristics of study participants by educational attainment, Seattle Social Development Project, 2024 (N=613)

Characteristic	*Total (n=613)*	*Completed a 4-year college degree or more (n=156)*	*Did not complete a 4-year college degree (n=457)*
Race and ethnicity, n (%)			
Asian	82 (13%)	37 (24%)	45 (9.9%)
Black or African American	127 (21%)	14 (9.0%)	113 (25%)
Hispanic or Latino	28 (4.6%)	8 (5.1%)	20 (4.4%)
Indigenous	72 (12%)	7 (4.5%)	65 (14%)
Native Hawaiian or Pacific Islander	41 (6.7%)	8 (5.1%)	32 (7.2%)
White	263 (43%)	82 (53%)	181 (40%)
Sex, n (%)			
Female	323 (53%)	91 (58%)	232 (51%)
Male	290 (47%)	65 (42%)	225 (49%)
Prior History of Binge Drinking or Other Substance Use, n (%)	287 (47%)	47 (30%)	240 (53%)
Perceived Social Cohesion Score			
Mean (SD)	7.4 (1.7)	7.4 (1.6)	7.5 (1.7)
Median (IQR)	7.0 (6.0, 8.0)	7.0 (6.0, 8.0)	2690 (2.8)
Min to Max	0.0, 13.0	2.0, 12.0	0.0, 13.0
Meeting SUD Criteria, n (%)	181 (30%)	33 (21%)	148 (32%)
Meeting SUD criteria for **alcohol**	144 (23%)	31 (20%)	113 (25%)
Meeting SUD criteria for **cannabis**	76 (12%)	5 (3.2%)	71 (16%)
Meeting SUD criteria for **other drugs**	86 (14%)	5 (3.2%)	81 (18%)

Table 2. Prevalence Ratios for the Association Between Educational Attainment and SUD

	Prevalence Ratios (95% CI)	*p-value*
Unadjusted	1.53 (95% CI: 1.10, 2.13)	0.01
Adjusted [a]	1.17 (95% CI: 0.84, 1.65)	0.36

[a]Adjusted for previous substance use at age 18, sex, and race and ethnicity

Table 3. Prevalence Ratios for the Association Between Educational Attainment and SUD stratified by perceived neighborhood social cohesion adjusted for covariates[a]

	Prevalence Ratios (95% CI)	*p-value*
Stratification		
Low social cohesion	1.23 (95% CI: 0.72, 2.08)	0.45
High social cohesion	1.17 (95% CI: 0.75, 1.83)	0.50

[a] Adjusted for previous substance use at age 18, sex, and race and ethnicity

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