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# Concordance Between Substance Use Self-Report and Hair Analysis in Community-Based Adolescents

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## Abstract

**Background.—**Accurate drug use identification through subjective self-report and toxicological biosample (hair) analysis are necessary to determine substance use sequelae in youth. Yet consistency between self-reported substance use and robust, toxicological analysis in a large sample of youth is understudied.

**Objectives.—**We aim to assess concordance between self-reported substance use and hair toxicological analysis in community-based adolescents.

**Methods.—**Hair results by LC-MS/MS and GC-MS/MS and self-reported past-year substance use from an Adolescent Brain Cognitive Development (ABCD) Study subsample (N=1,390; ages 9–13; 48% female) were compared. Participants were selected for hair selection through two methods: high scores on a substance risk algorithm selected 93%; 7% were low-risk, randomly selected participants. Kappa coefficients examined concordance between self-report and hair results.

**Results.—**10% of youth self-reported any past-year substance use (e.g., alcohol, cannabis, nicotine, opiates), while a mostly non-overlapping 10% had hair results indicating recent substance use (cannabis, alcohol, non-prescription amphetamines, cocaine, nicotine, opiates, and fentanyl). In randomly selected *low-risk* cases, 7% were confirmed positive in hair. Combining methods, 19% of the sample self-reported substance use and/or had a positive hair sample. Kappa coefficient of concordance between self-report and hair results was low (kappa=0.07; p=.007).

**Conclusions.—**Hair toxicology identified substance use in high-risk and low-risk ABCD cohort subsamples. Given low concordance between hair results and self-report, reliance on either method alone would incorrectly categorize 9% as non-users. Multiple methods for characterizing substance use history in youth improves accuracy. Larger representative samples are needed to assess the prevalence of substance use in youth.

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**Keywords**

children; adolescents; hair toxicology; substance use; substance use onset; self-report concordance

## Introduction

Adolescent substance use is a serious public health issue, with 15% of 8th graders (ages 13–14) reporting past-year cannabis use, 26% alcohol use, and 23% vaping nicotine (1). Substance use during adolescence is linked to a range of concerning outcomes, such as poorer academic achievement (2, 3), cognitive deficits (4, 5), and changes in brain architecture and function (6, 7). Yet conflicting results suggest substance use, even during this vulnerable age, is not always associated with negative outcomes (7, 8). A long-standing issue in substance use research, and in children and adolescents in particular, is reliance on self-report (9).

Self-report has several strengths. Qualitative information on substance use methods and detailed patterns are more easily garnered via interview, and simultaneous use of multiple substances is measurable. Self-report can be obtained flexibly through multiple modalities (anonymous survey, interview), making it cost effective. Further, self-reported substance use measures are reliable and valid (e.g., the Timeline Followback) (10–15). Still, there are concerns about numerous influences shaping a teenager's accuracy in reporting substance use history, including privacy (16, 17), forgetting, lack of knowledge regarding substances (16), sociodemographics (e.g., younger males) (18), and mental health (19). It was previously suggested to combine self-report with objective toxicology to improve accuracy (15), although to date this was not broadly applied to youth samples.

Hair is a beneficial biosample for measurement of substance use and exposure in youth. After proper wash procedures to remove environmental contamination (20, 21) and undergoing gas or liquid chromatography with tandem mass spectrometry (GC-MS-MS or LC-MS-MS), detection of substance use is valid (20). Typically trimmed to 3–4 cm, hair represents a 3-month window of detection of substance use—much longer than urine, blood, or oral fluid assessments. This longer window of detection is important in ensuring accurate substance use identification and preventing underreporting. Hair samples are easy to collect and store at room temperature, but there are technological issues including use of low thresholds to increase sensitivity (20) and proper washing procedures to remove environmental exposure. Basic drugs bind to melanin (22) in darker hair resulting in a color bias for drug incorporation (23), and parent drug analytes (e.g., THC, cocaine) have a higher binding affinity than their more polar metabolites (24) (e.g., THCCOOH, benzoylecgonine). In addition, hair analysis does not typically detect substance use within 7–10 days of use because of the time required for substance-embedded hair to reach the surface of the scalp. Given the unique strengths and weaknesses of self-report and drug toxicology, *combining both methods* optimizes identification of substance use and permits more accurate assessment of the sequelae of substance use in youth.

Few studies examined the impact of utilizing hair toxicology to detect substance use in youth. The largest known study (n=874) examined substance use in 14–15-year-olds in

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Italian public schools, with hair analysis detecting greater alcohol and nicotine exposure than self-report (25). Recent evidence from our group suggests hair testing detected more substance exposure than self-report alone in 9–12 year-olds, including detection of cannabinoids, alcohol, nicotine, and cocaine (26). Others similarly estimated that youth under-report their substance use (most commonly for cannabis, alcohol, and opiates, 17, for nicotine and alcohol, 25), with a systematic review finding low-to-moderate concordance between biosamples and self-report in adolescents and young adults (9). This is concerning, as inaccurate data obscure full determination of substance-related consequences.

Substance use histories of pre-adolescent and adolescent youth in the Adolescent Brain Cognitive Development℠ study (ABCD Study®) were assessed by self-report and hair toxicology (27, 28). Concordance between self-report and hair results was examined, hypothesizing that hair analysis would identify more substance users than reliance on self-report alone. These analyses further extend prior research by including a low-risk randomly selected subsample to provide initial data on high-risk v. low-risk cases of substance use identification.

## Materials and Methods

The ABCD Study is a 21-site, longitudinal study following 11,878 youth from ages 9–10 through 19–20. Recruitment efforts were guided by census data to ensure a diverse and generalizable sample (29). The present analysis evaluates data from Annual Release 4.0 (October 2021; http://dx.doi.org/10.15154/1523041), including data from baseline (Year 0; starting in 2017) through the 3rd annual follow-up visit (including data into 2021). Hair samples and self-reported substance use data were collected by trained research assistants at each site during the same study visit. All participants and their parents/guardians provided written assent/consent, and a centralized Institutional Review Board approved the study.

### Participants and Selection of Hair Samples for Testing.

Hair samples were collected from all willing participants with appropriate hair, though only a small subsample were assayed due to financial constraints. Two separate methods were employed for selecting which hair samples to test: (1) an evidence-based algorithm prioritized high-risk participants for hair testing (n=1,287; details in (26)), https://osf.io/mtp4k/) and (2) 103 low risk participants who denied any substance use and scored <3 on the algorithm were randomly selected. In addition, samples from baseline were excluded from random selection; selection was otherwise random across years. A total of 1,390 hair samples were available from 1,262 participants, as 120 participants had hair assayed from at least two study visits.

### Measures

**Sociodemographics.—**At baseline, parents reported sociodemographic characteristics including youth sex at birth, combined family household income, and parental education (30). Sociodemographic characteristics include social constructs only interpreted with inclusion of careful, appropriate contextualization factors (31). Therefore, some

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sociodemographic characteristics are included here to aid in understanding the subsample though interpretation is limited.

**Substance Use Interview.—**Full description is available elsewhere (27). All participants underwent confidential substance use interviews assured that no one, not even their caregiver, were privy to results; gating questions (e.g., "have you heard of ____ [substance]?") guided prompts into participants' reported knowledge of drugs and self-reported use so as to not query use of substances that were not already known to the participant. All substances were queried for use in the past year or since their last study visit, except for Baseline when they reported lifetime use; total past year use is included in the present analyses. Participants were asked if they had sipped alcohol, had a standard alcoholic drink, puffed or smoked tobacco cigarettes, e-cigarettes, or tobacco products, puffed, smoked or consumed cannabis products (including synthetic cannabinoids). They were also asked about use of recreational (non-prescribed) CBD, cocaine, methamphetamine, amphetamine, opiates, Vicodin, tranquilizers, bath salts, MDMA, ketamine, GHB, LSD, magic mushrooms, salvia, steroids, inhalants, prescription stimulants, prescription opioids, prescription sedatives, over-the-counter cough syrup, or any other substance use. Each drug class was individually queried, with examples of common terms used. For example, they were asked if they had used, "heroin, opium, or junk, smack or dope" or "GHB, liquid G, or Georgia home boy". Drugs that are prescribed were separately queried; e.g., they were asked about using "prescription pain relievers such as Vicodin, Lortab, Norco, Hydrocodone, OxyContin or Percocet that you used in a way your doctor did not direct you to use them (this does not include OTC pain relievers such as aspirin, Tylenol or Advil)". Full description of how each substance was queried is available in Lisdahl et al (27). As a validity check, participants were also asked if they had used a fictional drug; no use was reported.

**Multi-Matrix Testing for Acute Toxicology.—**A random sample of participants were selected to undergo acute toxicological testing to assess past 12–72 h substance use; the exact percentage tested varied by study year. In addition, participants who reported past-year substance use also received acute toxicology testing. Oral fluid was tested by the Dräger Drug Test® 5000 (DT5000; Dräger Inc., Houston, TX) for a 7-panel drug screen (cocaine, opiates, cannabis, benzodiazepines, amphetamine, methamphetamine, and methadone). Recent alcohol use was assessed with an ethanol breathalyzer test, and nicotine use with NicAlert strips (JANT Pharmacal, Encino, CA) for urinary cotinine. See supplement for windows of detection by methodology and for acute toxicology results relative to hair in the present sample.

## Hair Sample Collection and Analysis

Trained research assistants collected hair samples per standardized procedures from participants with hair longer than 1cm at each annual study visit; 100 mg of 3.9 cm hair closest to the root was required for all analyses. All hair samples are stored until selected for analysis. Selected samples were shipped to Psychemedics (Culver City, CA). Hair was trimmed to 3.9 cm and enzymatically digested and screened by FDA-cleared immunoassays or directly by LC-MS/MS (for cannabinoids and ethyl glucuronide [EtG]). To reduce false-positive risk from environmental exposure, hair was washed in a 15-minute wash

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procedure with 2 mL isopropanol per 12 mg hair, three 30-min phosphate buffer washes, and two 60-min phosphate buffer washes (32). Presumptive positives were confirmed and quantified by LC-MS/MS or GC-MS/MS analysis (32, 33). Tested drug classes included alcohol, amphetamines, benzodiazepines, cannabinoids, cocaine, fentanyl, opioids, nicotine, and phencyclidine.

### Statistical Analysis

R version 4.1.0 (34) via RStudio (35) was employed for all statistical analyses. Sociodemographics were examined for the whole sample, and subdivided by hair results, self-reported substance use, and randomly selected low-risk cases. Hair that was properly washed and confirmed by mass spectrometry are reported. Two separating grouping methods were used to consider possible sociodemographic and self-reported substance use differences; one comparison was conducted between positive and negative hair toxicology results, and one was conducted between those who self-reported any substance use and those who didn't. In both instances, chi-square and ANOVAs were run, with full results included in the supplement. Similarly, differences in hair results by randomly selected low-risk samples were examined. Kappa coefficients between hair and self-reported results were calculated and determined significant at a $p<.05$ threshold.

While 1,390 hair samples were available, 120 samples were from the same participants at different study visits. Due to concerns of assumption of independence, analyses were run with all available hair samples and then again excluding all participants with more than one time point of hair analysis; results remained the same in either case. Hair samples with self-report from the corresponding time point are reported and described as cases.

## Results

### Hair Collection and Sociodemographics

Of the entire cohort, 68% (22,484/33,248) of in-person study visits provided hair samples (Baseline through Year 3 follow-up); 4% of participants declined to give a hair sample and 23% had hairstyles that prevented collection. Six percent (1,390/22,484) of collected hair samples were analyzed. Case sociodemographics with positive and negative hair results are included in Table 2. For a relative comparison of current subsample's sociodemographics to the full cohort, see supplement.

The average age of cases with hair analyzed was 11.3 years (SD=1.2) and 48% were female. 1% were Asian, 5% were Black, 18% were Hispanic, 12% were "Other", and 64% were White. 26% had a household income below $50,000, 27% had an income between $50,000 and less than $100,000, and 40% had an income >$100,000. Parental education fell to 4% for <HS diploma, 8% with a HS diploma/GED, 28% with some college, 27% with Bachelor's, and 34% with a post graduate degree. 26% of samples were from Y1, 33% were from Y2, 10% from Y3, and 31% from Baseline.

In only the random sample (n=103), the mean age was 11.5 years (SD=0.9) and 54% were female. No randomly selected participants were from Baseline; 57% were from Year 1, 37% from Year 2, and 6% from Year 3 Follow-Up. When comparing higher risk and randomly

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selected participants, there were no significant group differences in sex or parental education or income.

## Hair Analysis Results

**Primary Results.—**Test results revealed that 225/1,390 (16%) high- and low-risk cases screened positive. After removing those who had legitimate explained use (i.e., prescription stimulants for attention deficit hyperactivity disorder), 163/1,390 (12%) screened positive for at least one drug without explanation. After undergoing a wash procedure and confirmation analysis via mass spectrometry, 145 (10%) confirmed positive for at least one drug (positive drug classes presented in Table 2; drug analyte information is available in the supplement). Cannabinoids were most commonly positive (6.1%), followed by alcohol (1.9%), non-prescription amphetamines (1.9%), and cocaine (1.7%). Less than one percent of participants tested positive for nicotine, opiates, or fentanyl, and no participants were positive for benzodiazepines or PCP. Notably, 0.9% of participants had at least one substance that screened positive but was not confirmed due to insufficient quantity of hair for analysis. While some of the insufficient samples were from cases whose hair confirmed positive for at least one other drug, others had no other drugs confirmed.

**Randomly Selected Sample Results.—**Analysis of the low-risk randomly selected subsample (103/1,390, or 7%) showed that 7% of randomly selected cases were confirmed positive for one or two drug classes. Cases were positive for cannabinoids, alcohol, cocaine, and/or nicotine. As in the full hair sample, insufficient samples prevented confirmation analysis of several additional positive screens (for unprescribed benzodiazepines and/or cannabinoids).

## Self-Reported Substance Use

Fifty-four percent of cases reported sipping alcohol, 3% reported consumption of a full drink, 5% more than puffed nicotine, and 3% endorsed cannabis use. In addition, 0.9% synthetic cannabinoids, and several reported use of CBD-only products for non-medical use, recreational (non-prescribed) amphetamines, cough syrup, recreational (non-prescribed) Vicodin, tranquilizers, bath salts, and/or inhalants. “Other” substance use was reported by fewer than 10 participants. In total, 10% (136/1,390) of cases reported more than experimental substance use (i.e., more than a sip or puff of alcohol, nicotine, or cannabis products). Sociodemographics by substance use reporting are included in Supplemental Table 2.

## Concordance between Hair Toxicology and Self-Report

Of the 136 cases that self-reported *any* substance use (mostly in the past year) and 145 whose hair samples were positive for *any* drug (with about a 3-month detection window), concordant results were found for only 23 cases. Restricting the report to drug classes detected by hair analysis protocols, 22 cases’ hair and self-report were concordant; 76% of cases’ self-reported drug use was not detected in hair and 7% of reported drug use not tested for in hair. Agreement between indicators of any overall substance use were low but significant, with a Kappa coefficient of 0.07 (z=2.71, $p$=.007). Ten percent (n=136) of cases self-reported any substance use and a largely separate 10% (n=145) of cases

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were recreational substance users based on hair analyses, yielding a total of 249 or 19% of substance use cases identified based on self-report and/or hair results (see Figure 1). Hair toxicology revealed an additional 123 (9%) cases of recreational drug use. Kappa coefficients for each individual drug class are reported in Supplemental Table 5, with cannabis as the only substance with significant (though again low) concordance between hair results and self-report (kappa=0.15, z=5.84, p<.001). Prevalence comparisons of hair and self-report by drug class are reported in Figure 2.

## Discussion

Substance use research heavily relies on self-report to acquire participant history, though there are known limitations to the methodology. Concordance of pre-adolescent and adolescent self-report with objective, robust toxicological hair assessment in high- and low-risk participants (n=1,390) was investigated in the ABCD Study dataset. Several findings were of note: in a sample of mostly high risk 9–13 year-olds, (1) 10% self-reported substance use, (2) 10% had hair that was confirmed positive for substance use, (3) concordance between hair and self-report was low, and (4) hair analysis in addition to self-report revealed a unique additional 9% of substance use cases over and above self-report alone, nearly doubling the number of identified substance users to 19%. Finally, in a small, randomly selected low-risk sample (n=103), 7% of cases were positive for substance use based on hair analysis. Total substance use is most likely underestimated because additional cases screened positive, but there was insufficient hair to confirm positive screening results.

One of the most notable results from the present analysis is the implication of underreporting in substance use studies of adolescents. A recent systematic review similarly suggested that concordance between self-report and biospecimens of substance use are low-to-moderate in studies of adolescents and young adults (9). While the full extent of underreporting requires more broad-based toxicological testing, these preliminary results should give pause to researchers. The utility and necessity of self-report is undeniable—not only from a practical standpoint, but, as reflected here, individuals who self-report substance use may be revealing information that would not be detected in other forms of measurement. At the same time, until there are improved estimates of substance use prevalence and better methods for confirming group status (i.e., whether a participant is truly a “control” in a substance use study), null results of differences between “substance users” and “controls” may not actually represent lack of difference between substance users and non-users, but rather indicate an issue with data collection and grouping methodology. Extrapolating from the present results, this is especially true in high-risk samples, but may also be important even with low-risk participants. Combining hair toxicology results with self-report is suggested for accurate determination of substance use history to investigate substance-related consequences.

Self-report has its own strengths, and it is inappropriate to disregard it in favor of toxicological assessment alone. Nearly 10% of cases whose hair was tested reported use of at least one standard dose of a substance in the past year. As the vast majority had negative hair results despite reported use, this is likely due to hair analysis requiring moderate levels of substance use for detection (36, 37); for example, hair assays are not sensitive enough to

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detect only one standard drink of alcohol or smoking one cannabis joint. Participants can self-report use over a longer period of time than toxicological assessments measure. Further, detailed quantity/frequency and co-use information cannot be collected with toxicology. Thus, self-report is beneficial for determining initial and early substance use behaviors. Youth may be most willing to disclose substance use at a low level but less likely when frequent patterns emerge (e.g., at levels detectable in hair). If so, this would contrast with data in adults, which found more concordant hair and self-report in more frequent and higher dose users (38), and potentially represent adolescent-specific characteristics.

A surprising finding was the rate of positives within the randomly selected low-risk ABCD participants. These cases had minimal risk factors for substance use according to the hair selection risk algorithm, yet were positive for alcohol, nicotine, cannabis, and/or cocaine. This further elevates the concern beyond self-report in high-risk participants, but also in healthy, low-risk (i.e., no substance use experimentation, minimal psychopathology, peer use, or family history of substance problems) samples as well. Another study employing a convenience sample of healthy adolescents found 2% of participants who denied nicotine or cannabis use had positive urine tests suggesting recent use (39). As few low-risk samples were tested, the ABCD Study continues to test randomly selected low-risk cases to better gauge the extent of misreporting.

The most commonly identified drug class in hair was cannabinoids. Importantly, both THCCOOH and specific parent analytes such as THC and CBD were detected, with THC representing the largest single drug analyte (4.6%) followed by THCCOOH (2%). THCCOOH is necessary to confirm ingestion of cannabis (20, 40), while THC or CBD may indicate cannabis use or environmental (e.g., secondhand) exposure. Washing procedures reduce false-positive results from environmental exposure (20, 32) and THC detection alone can occur (40). THCCCOH incorporates poorly into hair, particularly due to the low binding affinity with melanin (22, 40). Thus, cannabis use was the most frequently used substance, although was rarely self-reported.

Notable strengths to these findings are use of well-validated substance use history detection paradigms: the TLFB for self-report and hair analysis. A recent systematic review (9) notes two salient factors for concordance between biosamples and self-report: length of retrospective self-report, with longer self-reported recall periods reducing concordance; and use of validated metrics improving concordance. Methods of substance use measurement vary in windows of detection (see Supplemental Table 1) representing one reason for low concordance rates. While hair is optimal for examining longer histories of use, 7–10 days are required for the drug to be incorporated into the hair shaft and for growth out of the scalp. Further, though a panel of drugs were tested in hair, not all possible drugs were tested and so hair results may be further underestimated. Use of the well-validated TLFB likely increased the scientific integrity of the present results and represents a strength of the overall ABCD Study. Participants were queried on past 12-month self-report, whereas hair was trimmed to 3–4 cm to indicate past 3-months substance use; thus, measurement periods varied and impact concordance rates. Future years of ABCD Study data will include TLFB summary data for 3-months in addition to past-year, which will better map on to the window of detection in hair. In addition, amount of substance use by youth may be

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too low for hair detection (41), as frequent use of substances is thought to be relatively uncommon in this age group. Though inclusion of a randomly selected low-risk hair samples is novel and informative, the sample here was small. This issue will diminish over time as data accumulate over time with the recent inclusion of this category in the ABCD testing protocol. Certain populations of participants may not have hair styles that are long enough to be sampled or may not feel comfortable giving a hair sample. Examination of sociocultural factors which may influence reporting and/or hair results is beyond the scope of this paper, though use of culturally informed collection methods are important to reduce bias (42). Given these concerns, findings are not generalizable to the full ABCD Study cohort. Finally, number of positive hair analysis results may also be underestimated due to insufficient quantity of hair to complete all analyses.

In summary, use of hair assessment and self-report identified 19% of mostly high-risk cases as substance users. In addition, 7% of a small sample of randomly selected low-risk cases also tested positive for drugs in hair despite denying substance use when queried. Thus, use of objective toxicological assessment (hair) in addition to self-report revealed an additional 9% of substance users. Incorporation of toxicological hair data nearly doubled the estimated prevalence of substance use in this sample. Combining data collection methodologies is likely important in studies of both high- and low-risk healthy adolescent samples to accurately determine sequelae of substance use. Use of hair samples in a larger, randomly selected healthy developing cohort is needed to assess general prevalence of substance use in youth.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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### Author Disclosures

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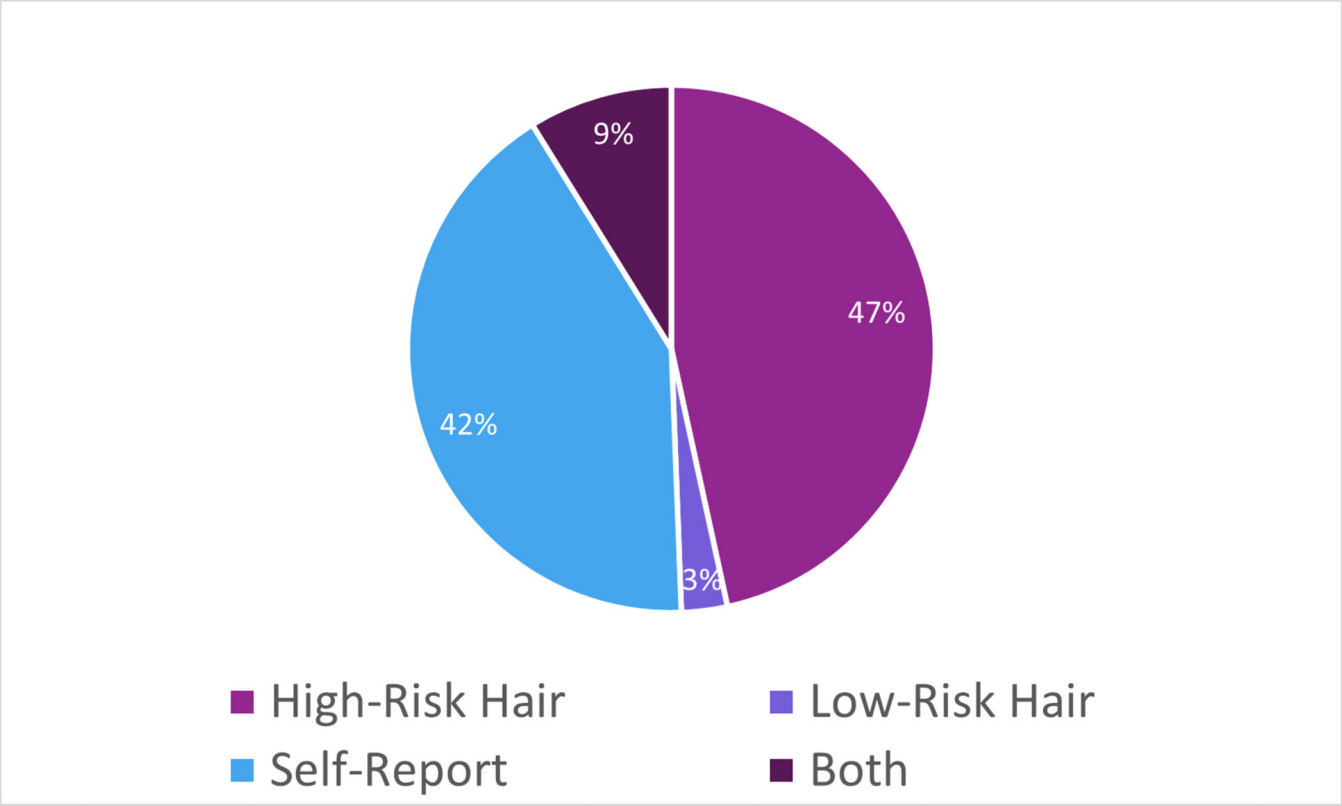


**Figure 1.**

Pie chart depicting substance use by detection method and grouping

Notes: Percentage represents number of cases in each category of the total (n=249). “High-Risk Hair” indicates cases positive for hair testing and whose hair was selected due to scoring relatively high on the hair selection risk algorithm; “Low-Risk Hair” indicates cases that scored low on the hair selection algorithm and were randomly selected for hair analysis; “Self-Report” indicates cases that reported any substance use; “Both” indicates cases with positive hair results and self-report of any substance use. As per NIDA and ABCD Study reporting requirements, cell sizes <10 are obscured.

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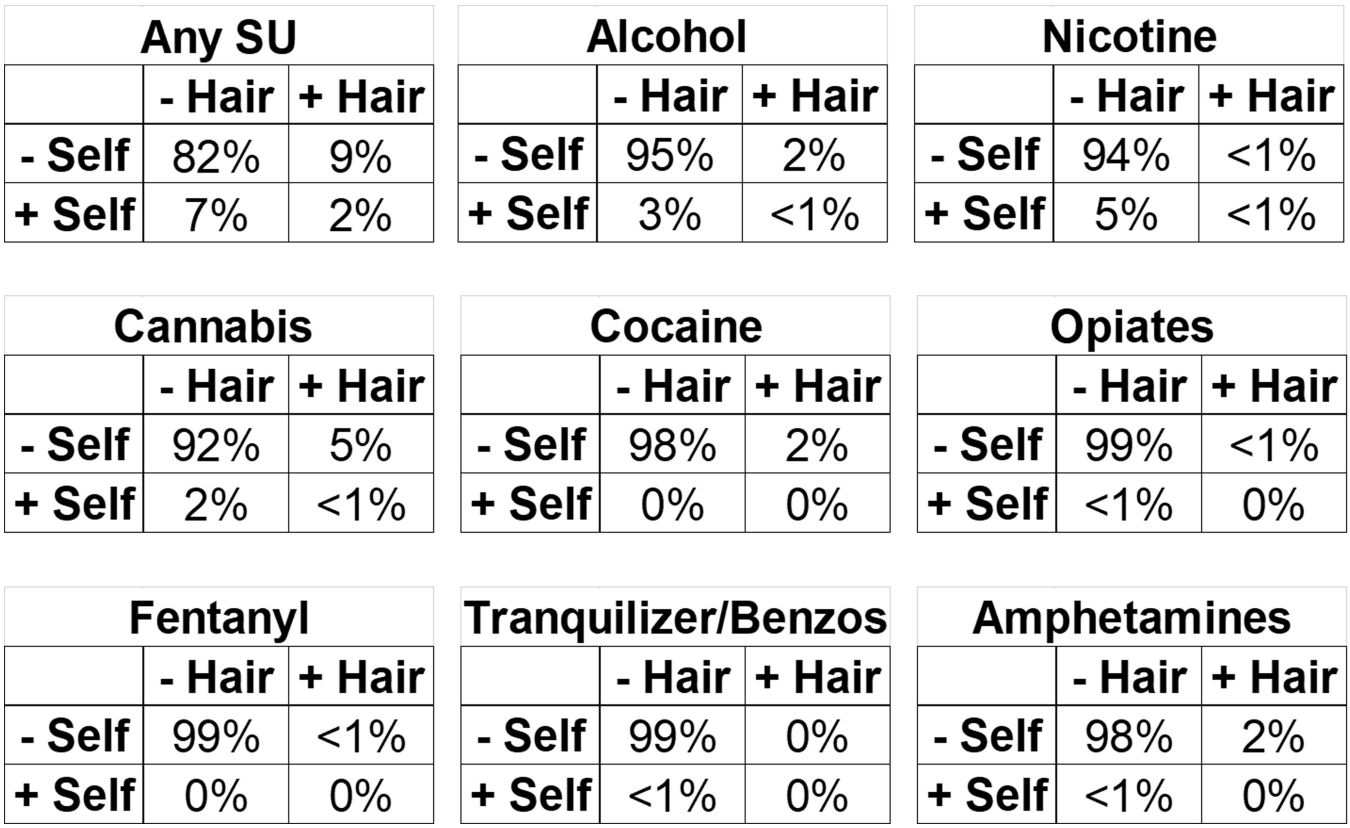

| Any SU | - Hair | + Hair |
|---|---|---|
| - Self | 82% | 9% |
| + Self | 7% | 2% |

| Alcohol | - Hair | + Hair |
|---|---|---|
| - Self | 95% | 2% |
| + Self | 3% | <1% |

| Nicotine | - Hair | + Hair |
|---|---|---|
| - Self | 94% | <1% |
| + Self | 5% | <1% |

| Cannabis | - Hair | + Hair |
|---|---|---|
| - Self | 92% | 5% |
| + Self | 2% | <1% |

| Cocaine | - Hair | + Hair |
|---|---|---|
| - Self | 98% | 2% |
| + Self | 0% | 0% |

| Opiates | - Hair | + Hair |
|---|---|---|
| - Self | 99% | <1% |
| + Self | <1% | 0% |

| Fentanyl | - Hair | + Hair |
|---|---|---|
| - Self | 99% | <1% |
| + Self | 0% | 0% |

| Tranquilizer/Benzos | - Hair | + Hair |
|---|---|---|
| - Self | 99% | 0% |
| + Self | <1% | 0% |

| Amphetamines | - Hair | + Hair |
|---|---|---|
| - Self | 98% | 2% |
| + Self | <1% | 0% |

**Figure 2.**

Charts of self-reported substance use (SU) relative to hair toxicology results.

Notes: Percentages within the charts represent the percentage of cases falling into each respective category. Hair results were confirmed by mass spectrometry. “+ Hair” indicates positive confirmed hair analysis results. “+ Self” indicates self-reported full dose of substance. “- Hair” indicates hair was negative on screening or confirmation testing of hair; hair with insufficient quantity to test for confirmation is included within “- Hair”. “- Self” indicates either the participant denied use of a fully standard dose of the substance on query or was not queried due to question gating (e.g., participant reported never having heard of the substance). Non-medicinal, non-prescribed use of substances (i.e., opiates, tranquilizers or benzodiazepines, amphetamines, and cannabinoids including CBD) are included; prescribed use is not included in “+ Hair” or “+ Self”. As per NIDA and ABCD Study reporting requirements, cell sizes <10 are obscured.

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**Table 1.**

Sociodemographic differences by positive and negative hair toxicology results.

| | Hair Positive N=145 | Hair Negative N=1245 | *p*-values |
|---|---|---|---|
| Age (Mean, SD, years) | 11.5 (1.3) | 11.2 (1.2) | *ns* |
| Female (%) | 40% | 49% | $p = .02$ |
| Parental Education (%) | | | $p < .001$ |
| <HS Diploma | 9% | 3% | |
| HS Diploma/GED | 20% | 6% | |
| Some College | 44% | 26% | |
| Bachelor | 15% | 29% | |
| Post-Graduate | 12% | 36% | |
| Yearly Family Income (%) | | | $p = .03$ |
| <$50,000 | 54% | 23% | |
| ≥$50,000-≤$100,000 | 20% | 28% | |
| ≥$100,000 | 19% | 43% | |
| ABCD Session (%) | | | *ns* |
| Baseline | 27% | 31% | |
| Year 1 Follow-Up | 19% | 27% | *ns* |
| Year 2 Follow-Up | 41% | 33% | |
| Year 3 Follow-Up | 14% | 10% | |

Notes: SD=standard deviation; *ns*=nonsignificant; p-values for ANOVA models with all sociodemographic factors included to determine predictive utility of group status, with only complete cases used; if a significant difference ($p < .05$) was found between groups, the p value is listed; sum totals of categories which are less than 100% are due to participants reporting “Don’t Know” or “Refuse to Answer”.

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**Table 2.**

Confirmed positive hair toxicology results by drug class.

| Drug Class | % of Sample Tested |
|---|---|
| Cannabinoids | 6.1% |
| THCCOOH-only | 2.0% |
| Alcohol | 1.9% |
| Amphetamines (non-Rx) | 1.9% |
| Cocaine | 1.7% |
| Nicotine | <1% |
| Opiates | <1% |
| Fentanyl | <1% |
| Benzodiazepines | -- |
| PCP | -- |
| Any Positive Result | 10.4% |

Notes: No drug class is mutually exclusive. PCP=phencyclidine. All results were confirmed by mass spectrometry. Results do not include positive tests for prescribed medications (e.g., amphetamines). Positives results indicate any positive analyte from an overall drug class (e.g., for cannabinoids, THC, THCCOOH, CBD, CBN, and/or THCV).