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ADVANCES IN Toxicology and Toxic Effects OPEN ACCESS JOURNAL

DOI: https://dx.doi.org/10.17352/atte

Research Article

Studying illicit substance exposure among urban adolescents using forensic science

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Received: 28 November, 2023
Accepted: 20 December, 2023
Published: 21 December, 2023

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Keywords: Wipe sampling; Substance exposure; Toxins; Urban; Adolescents

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Abstract

There are critical challenges to measuring substance use exposure, particularly among adolescents, with major limitations to the most common methods of assessment – self-report and biomarker (urine, saliva) analysis. This study examines the use of wipe sampling as a measure of adolescent illicit substance exposure. Among low-income families, this study compared forensically analyzed wipe samples from 51 adolescents' homes and cell phones with self-reported substance use to identify overlaps and discrepancies. There were major gaps between adolescents reporting any substance use in the past year and adolescents whose homes and/or cell phones tested positive for illicit substances via wipe sample analysis. This study builds upon previous adolescent substance use and exposure research, highlighting the profound limitations of self-reported use, and introducing wipe sampling as an effective measure of toxicant exposure. Wipe samples also provide a means to examine environmental contexts in new novel ways.

Introduction

Exposure to illicit substances in adolescence is associated with future health [1,2]. Typical methods for examining substance exposure involve self-report and biomarker assessments (i.e., saliva samples, urianlysis [2,3]). While both methods have merit, they present several methodological concerns. Although self-reporting is inexpensive and convenient, it's susceptible to social desirability and shows low validity, particularly among users [4]. Self-report methods often require these limitations to be addressed using alternate measurement tools such as biomarkers. However, biomarkers are limited by substance detection below standardized cut-offs, have a narrow timeframe for substance use detection, and are limited in the ability to identify exposure to substances. These methods also demonstrate high discordance, the two often do not match, making neither an adequate measure of exposure [3]. Alternatively, wipe sampling has shown promising results as an alternative that can be utilized in different settings (e.g., hospitals, family homes [5,6]) and can identify exposure to various toxicants including pharmaceutical drugs, pesticides, and bacterial contaminants [7] over an extended period of time [2]. However, wipe sampling has not been directly compared to self-report methods of adolescent substance use or exposure. This study utilized wipe sampling to assess exposure to illicit substances among a low-income, urban population. This is a high-risk population likely to have low concordant results for self-report and biomarker assessment and present a high risk of substance use from adolescence to adulthood [8].

Citation: Merten MJ, Gryzwacz JG, Wagner JR, Terrell AL, Claybrook TC, et al. (2023) Studying illicit substance exposure among urban adolescents using forensic science. Adv Toxicol Toxic Effects 7(1): 028-031. DOI: https://dx.doi.org/10.17352/atte.000015

Methodology

Sample

Following university IRB approval and participant informed consent and assent, a total of 91 parent-adolescent dyads participated in a larger, multi-faceted study approved by the IRB at one of the investigator's institutions. The present study used data from 51 adolescents residing in impoverished neighborhoods located in a Central United States city (40% female; M_{age} = 14.4, *SD* = 1.8). Adolescents identified as Hispanic/Latino descent (80%), African American (18%), White (78%), Native American/American Indian (2%), and more than one Race (2%; Table 1).

Measures

Self-report substance use: Adolescents were asked to report their frequency of marijuana use and other non-prescription drugs to get high in the past year using a 5-point Likert scale (1 = *Never*, 2 = *1-2 times*, 3 = *3-4 times*, 4 = *5-6 times*, 5 = *7+ times*).

Exposure to illicit substances: Exposure to illicit substances was examined using wipe sampling where wipes were swiped on a total of four surfaces within the adolescent's home: the living room table, refrigerator, bedside table in the adolescent's bedroom, and the adolescent's cell phone.

Procedure and analysis

After obtaining parental consent and youth assent, adolescents were asked to complete a paper questionnaire with items on substance use. Wipe samples were collected by trained study staff from (a) three household locations within each home: the refrigerator door, the countertop of the bathroom that the adolescent typically uses, and the flat surface of a bedside table, dresser, or nightstand in the adolescent's room, and (b) the adolescents' cell phone. For the household locations, six individually packaged WEBCOL™ Alcohol preps that were presaturated with 70% isopropyl alcohol were used to wipe household surfaces. Each surface of the above-mentioned locations in the home was wiped using two WEBCOL™ Alcohol preps. The collection was performed by placing a 10 cm x 10 cm template, shaped like a frame, on the surface identified for sampling. The first wipe was unfolded and wiped back and forth horizontally across the area. Next, a second wipe was unfolded and the surface was wiped vertically back and forth across the area within the template. This procedure was repeated for all household surfaces that were identified for inclusion in the study. All six of the wipes were pooled together as a single composite sample and placed in a 50mL centrifuge tube labeled with information such as sample number and collection date) and sent to a university laboratory for chemical analysis prior to being sent to a forensic toxicology laboratory for trace drug analysis. Regarding the adolescent cell phone wipe samples, a single Read Right® PhoneKleen™ wipe was removed from its individual packaging, unfolded, and wiped across the exterior of the cell phone. Each wipe was then placed in a labeled 50 mL conical centrifuge tube. Household and cell phone wipes were subsequently sent to a forensic toxicology laboratory for analysis using calibrators prepared with a positive (substance present) and negative (substance absent) control to test for illicit substances above standardized cutoff levels [9].

Wiebe developed the method that generated the data for this study [9]. Phone wipe samples were prepared via a methanolic extraction, while household wipe samples were prepared via a straight injection method or a solid phase extraction. Using a methanolic method, methamphetamine has previously been shown to have a recovery of 60% - 90% after drug deposition [10]. Both the phone wipe and household wipe samples were analyzed for trace amounts of drugs by liquid chromatography-tandem mass spectrometry (LC/MS/MS) using the same instrumental method parameters on an LC/MS 8040 system from Shimadzu. The results were compared to controlled samples containing prescription and illicit drugs. Validation data was analyzed separately from unknown samples with both positive and negative controls included. The detection of a drug was reported positive in a sample if the drug was detected in the positive control as well as had a quantitation value greater than the limit of detection as determined during validation.

Descriptive statistics were run to produce the following frequencies: (1) the percentage of adolescents who self-reported illicit substance use; (2) the percentage of adolescents who had a cell phone that had at least one illicit substance detected using wipe sampling; (3) the percentage of sampled households where at least one illicit substance was detected using wipe sampling.

Table 1: Demographic characteristics of adolescent study participants.

	%	N
Race		
White	78%	39
Black/African American	18%	9
Native American/American Indian	2%	1
More than one Race	2%	1
Latinx/Hispanic descent		40
Yes	80%	10
No	20%	
Gender		
Male	60%	30
Female	40%	20
Age		
11	2%	1
12	20%	10
13	10%	5
14	20%	10
15	20%	10
16	8%	4
17	20%	10

Note: N = 50; missing demographic data from one adolescent participant.

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Results

Wipe sample analysis from the three locations within a home determined that illicit substances were identified in a total of 13 of the 51 homes (Table 2). These substances included amphetamines (n = 2), methamphetamine (n = 8), Phencyclidine (PCP; n = 2), Δ9-Tetrahydrocannabinol (THC; n = 2), and cocaine (n = 4). Of the 13 homes where illicit substances were detected, six of those homes (46%) had an adolescent cell phone containing an illicit substance(s); including methamphetamine (n = 2), THC (n = 2), oxycodone (n = 2), oxymorphone (n = 2), 3,4-methylenedioxy-N-methamphetamine (MDMA; n = 1), and cocaine (n = 1). One cell phone sample detected four illicit substances. While homes detecting THC had overlapping detection of THC on the adolescent's cell phone, only two of the seven homes with methamphetamine detection had overlapping traces on corresponding cell phone samples. The remaining home samples did not show evidence of overlap on cell phone samples. MDMA, Oxymorphone, and oxycodone detected on cell phones were not found in the home. Regarding self-reported substance use within the past year, of the 13 homes where illicit substances were detected, only three had an adolescent who reported using illicit substances, with all three reporting marijuana use.

Discussion

This study examined the utility of wipe sampling as a possible alternative to self-report and biomarker data when assessing potential illicit substance exposure in households with an adolescent. Wipe sampling's sensitivity is an effective assessment for substance detection, even below standardized cut-offs. Additionally, the forensic analysis identified little overlap in three areas: substances detected in the homes and substances self-reported; substances detected on cell phones and substances self-reported; and substances detected in the homes and substances detected on cell phones. Apart from one adolescent self-reporting marijuana use and having a positive wipe for THC, none of the remaining youth in homes where substances were detected by wipe sample self-reported any substance use. The most common substance detected in the home was methamphetamine (7 of 13 homes). This supports the assertion that methamphetamine contamination in homes is an emerging public health concern [11]. Only a few cell phones had detectable traces of methamphetamine on them, while adolescents self-reported no methamphetamine use.

Homes contained other substances which were not found on cell phones and cell phone samples detected substances not found in the home. These findings suggest that participants are exposed to toxins within their home environment and either failed to accurately self-report the use of identified substances or participants were unknowingly exposed. Substances detected on the adolescents' cell phones but not within the home are more likely to reflect personal or peer use. Despite the contributions of this study, some limitations were noted. First, data were collected from a small sample of low-income families, which limits generalizability. Second, substance exposure does not necessarily equate to usage, although exposure presents its own health risks [8].

Table 2: Overlap between self-reported substance use and wipe-detected substances.

Sample #	Home Sample Substance Detected	Cell Phone Sample Substance Detected	Self-Report Substance Use
1	Cocaine	No	No
2	Methamphetamine	No	No
3	Cocaine	No	No
4	THC	Oxymorphone, THC	No
5	Methamphetamine	Oxycodone	No
6	Methamphetamine	No	No
7	Cocaine, methamphetamine, PCP, THC	Cocaine, methamphetamine, THC, MDMA	THC
8	Cocaine, PCP	No	No
9	Amphetamine	No	No
10	Methamphetamine	No	No
11	Methamphetamine	Methamphetamine	No
12	Amphetamines, methamphetamine	Oxycodone	No
13	Methamphetamine	Oxymorphone	No

Conclusion

This study builds upon previous adolescent substance use and exposure research, introducing wipe sampling as an effective method, for detecting exposure to environmental toxicants which may not be detected through alternative measures. Wipe sampling is an objective measure that, although scantly studied, provides a remedy for limitations associated with the timing of biomarkers, accuracy of self-report, and inconsistency between the two measures. Wipe samples have the capacity to detect toxicant exposure over a greater timespan and are more cost-effective than biomarkers. Furthermore, wipe sampling offers opportunities for research to examine environmental contexts, such as alternative places in the home and adolescents' possessions, which have not yet been explored. Future research on environmental toxicant exposure can employ wipe sampling to identify potential sources of adolescents' exposure to and use of substances.

References

1. Odgers CL, Caspi A, Nagin DS, Piquero AR, Slutske WS, Milne BJ, Dickson N, Poulton R, Moffitt TE. Is it important to prevent early exposure to drugs and alcohol among adolescents? Psychol Sci. 2008 Oct;19(10):1037-44. doi: 10.1111/j.1467-9280.2008.02196.x. PMID: 19000215; PMCID: PMC3664402.

2. Grange AH, Sovocool GW. Detection of illicit drugs on surfaces using direct analysis in real time (DART) time-of-flight mass spectrometry. Rapid Commun Mass Spectrom. 2011 May 15;25(9):1271-81. doi: 10.1002/rcm.5009. PMID: 21491529.

3. Napper LE, Fisher DG, Johnson ME, Wood MM. The reliability and validity of drug users' self reports of amphetamine use among primarily heroin and cocaine users. Addict Behav. 2010 Apr;35(4):350-4. doi: 10.1016/j.addbeh.2009.12.006. Epub 2009 Dec 16. PMID: 20053503; PMCID: PMC2821802.

4. Williams RJ, Nowatzki N. Validity of adolescent self-report of substance use. Subst Use Misuse. 2005;40(3):299-311. doi: 10.1081/ja-200049327. PMID: 15776978.

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5. Rose LJ, Hodges L, O'Connell H, Noble-Wang J. National validation study of a cellulose sponge wipe-processing method for use after sampling Bacillus anthracis spores from surfaces. Appl Environ Microbiol. 2011 Dec;77(23):8355-9. doi: 10.1128/AEM.05377-11. Epub 2011 Sep 30. PMID: 21965403; PMCID: PMC3233038.

6. Bobin-Dubigeon C, Amiand M, Percheron C, Audeval C, Rochard S, Leynia P, Bard JM. A new, validated wipe-sampling procedure coupled to LC-MS analysis for the simultaneous determination of 5-fluorouracil, doxorubicin and cyclophosphamide in surface contamination. J Anal Toxicol. 2013 Sep;37(7):433-9. doi: 10.1093/jat/bkt045. Epub 2013 Jul 4. PMID: 23828102.

7. Kiffmeyer TK, Tuerk J, Hahn M, Stuetzer H, Hadtstein C, Heinemann A, Eickmann U. Application and assessment of a regular environmental monitoring of the antineoplastic drug contamination level in pharmacies - the MEWIP project. Ann Occup Hyg. 2013 May;57(4):444-55. doi: 10.1093/annhyg/mes081. Epub 2012 Nov 2. PMID: 23125441.

8. Piehler TF, Véronneau MH, Dishion TJ. Substance use progression from adolescence to early adulthood: effortful control in the context of friendship influence and early-onset use. J Abnorm Child Psychol. 2012 Oct;40(7):1045-58. doi: 10.1007/s10802-012-9626-7. PMID: 22527607; PMCID: PMC3424390.

9. Wiebe TR. Detection of drugs from environmental wipe samples by liquid chromatography tandem mass spectrometry (LC/MS/MS) (Order No. 10139461). Available from Dissertations & Theses @ Oklahoma State University - Stillwater; ProQuest Dissertations & Theses Global. 2015 (1821913273). (Retrieved from http://argo.library.okstate.edu/login?url = https://www-proquest-com.argo.library.okstate.edu/docview/1821913273?accountid = 4117)

10. Abdullah AF, Miskelly GM. Recoveries of trace pseudoephedrine and methamphetamine residues from impermeable household surfaces: implications for sampling methods used during remediation of clandestine methamphetamine laboratories. Talanta. 2010 Apr 15;81(1-2):455-61. doi: 10.1016/j.talanta.2009.12.025. Epub 2009 Dec 21. PMID: 20188946.

11. Kuhn EJ, Walker GS, Whiley H, Wright J, Ross KE. Household Contamination with Methamphetamine: Knowledge and Uncertainties. Int J Environ Res Public Health. 2019 Nov 23;16(23):4676. doi: 10.3390/ijerph16234676. PMID: 31771211; PMCID: PMC6926576.

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