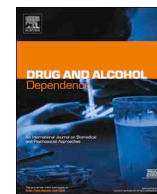


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Full length article

Elevated prevalence of antisocial behavior in adolescent children whose mothers misuse opioids

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ABSTRACT

Background: Past studies show that illicit opioid use may impair parents' ability to care for their children. However, few studies have examined adverse outcomes in adolescent children of mothers who misuse opioids. **Methods:** Data come from the National Survey on Drug Use and Health's nationally representative matched sample of mothers and their adolescent children who resided in the same household. The outcome of interest was whether adolescents engaged in aggressive or antisocial behaviors in the past year. Using logistic regression, adolescent children whose mothers engaged in past-year opioid misuse were respectively compared to children whose mothers used other illicit drugs, had an alcohol use disorder, or had no misuse of substances. To control for confounding, propensity scores were used to match the three other maternal substance use groups to mothers who misused opioids on a number of measured confounding variables.

Results: The odds of antisocial behaviors were 1.6 times higher among adolescent children whose mother engaged in past-year opioid misuse than matched adolescent children whose mothers reported no illicit substance use. There was no significant difference in antisocial behaviors between adolescents whose mothers misused opioids and either adolescents whose mothers used illicit drugs or had an alcohol use disorder.

Conclusion: As the United States seeks to respond to the needs of families impacted by its ongoing opioid crisis, it is likely that services will be needed not only for parents who misuse opioids, but also for their children, who are at elevated risk for adverse behavioral outcomes.

1. Introduction

The United States is in the midst of an opioid crisis characterized by historically high rates of overdose deaths, hospitalizations, and treatment admissions related to the misuse of prescription opioid medications and heroin (Kolodny et al., 2015). Increased awareness of the spread of opioid-related health problems has motivated a public health response to the current crisis (Alexander et al., 2015; Kolodny et al., 2015). With more than 30,000 Americans killed by an opioid overdose in 2015, the problem of overdose poisonings has now become so severe that, for the first time since the Centers for Disease Control and Prevention (CDC) began collecting data on injury deaths, an American is more likely to die of drug poisoning than in a motor vehicle crash (Rudd et al., 2016).

With 2.5–4.5 million Americans over age 12 suffering from an opioid pain-reliever or heroin use disorder (Kolodny et al., 2015), the consequences of adult opioid misuse are likely spilling over and impacting children and youth (Feder et al., 2018). There are a number of dangerous pathways by which increasing rates of opioid misuse by adults may be imposing harm on youth. First, opioid use during pregnancy has become more common (Patrick et al., 2012), and opioids can increase risk for preterm birth and impaired intrauterine growth (European Monitoring Center for Drugs and Drug Addiction, 2012). Second, parental substance use generally is associated with decreased attentiveness to children's needs and more authoritarian parenting styles (Mayes et al., 1997; Wellisch and Steinberg, 1980), and studies of children with mothers with an opioid use disorder (OUD) have found that parents with OUD are disproportionately likely to engage in

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coercive parenting and high-risk behavior for child abuse perpetration (Barnard and McKeganey, 2004; Dawe and Harnett, 2007). Third, parents who misuse opioids may also experience extended periods of separation from their child because of incarceration or specialty behavioral health treatment or placement of the child in the foster care system via child protective services (Kolar et al., 1994; McKeganey et al., 2002; Sanmartin et al., 2020). Finally, if opioid misuse progresses to the point of use disorder it can become enormously costly (Roddy and Greenwald, 2009), leaving dependents deprived of material resources (Barnard and McKeganey, 2004).

Each of these potential child harms may also increase the risk of children engaging in aggressive or antisocial behaviors in adolescence. As noted, opioid use in pregnancy increases risk for preterm birth, and preterm birth is associated with externalizing psychopathology like ADHD and conduct disorder in adolescents (Momany et al., 2017). Parents' opioid misuse may impair their capacity to supervise adolescent children; supervision is among the most important risk factors for male adolescent delinquency (Loeber et al., 2003). The problem of poor supervision is compounded by potential extended separation caused by incarceration or time spent in treatment. Parents' opioid misuse may divert resources and leave children growing up in poverty; poverty is a well-established risk factor for adolescent behavior problems (Mazza et al., 2017). Finally, maternal substance use is a known independent risk factor for adolescent delinquency (Loeber et al., 2003).

In spite of these well-known risks to youth, there is little research on the association of parents' opioid misuse and their adolescent children's behavior. This study seeks to close that gap by using a unique data source – a large, nationally representative sample of matched dyads of adolescents (aged 12–17) and their mothers residing in the same household. We focus on mothers because mothers are more likely to have caregiving responsibility for their children, and because more mother-child dyads were sampled than father-child. The study examines the following questions: 1) Do adolescent children of mothers who misuse opioids exhibit higher rates of aggressive and antisocial behaviors than their peers whose mothers do not engage in any problematic substance use? 2) Do adolescent children of mothers who misuse opioids exhibit higher rates of aggressive or antisocial behaviors than their peers whose mothers use other drugs illicitly, or have an alcohol use disorder, respectively?

2. Methods

2.1. Data

Analyses are informed by data from the 2002 to 2014 National Surveys on Drug Use and Health (NSDUH). The NSDUH is a nationally representative survey of the non-institutionalized population in the United States conducted annually by the Substance Abuse and Mental Health Services Administration (SAMHSA). Each year, the NSDUH collects detailed information from approximately 70,000 persons age 12 and older living in households about use of tobacco, alcohol, and illicit drugs. Respondents are also asked questions about demographic characteristics, mental health, and utilization of substance use and mental health treatment. Using a stratified, multi-level cluster sampling design, the survey is designed to produce representative estimates for individuals 12 and older living in households in the United States (Substance Abuse & Mental Health Services Administration, 2018).

2.2. Study sample

Each year, NSDUH also sub-samples pairs of one parent and one child aged 12–17 who reside in the same household. This pair-data component of the NSDUH is done by using a preprogrammed algorithm selection, which allows NSDUH to select either one or two persons for interview among all eligible household members and contains data on spouse or partner pair, parent-child pair, and sibling pair (Substance

Abuse & Mental Health Services Administration, 2014). This allows for analysis of matched mother-child and matched father-child dyads; however, because of the sampling scheme, these dyads must be analyzed separately (Ali et al., 2016). Therefore, the present analysis uses a sample of approximately 30,000 mother-child dyads drawn from the 2002 to 2014 NSDUH. Because the NSDUH's design precludes analysis of mothers and fathers together, we chose to focus on mothers because there was a larger sample of mothers, and because mothers are more often the primary caregiver.

2.3. Measures

2.3.1. Exposure

The exposure of interest was whether the mother member of the dyad reported any past year opioid misuse, defined in this study as either use of heroin, or use of a prescription pain reliever in a manner other than as prescribed by a doctor. Remaining dyads were sorted into three mutually exclusive comparison groups corresponding to different patterns of problematic substance use: 1) mothers who did not misuse opioids, but used at least one other illicit drug (marijuana, cocaine, hallucinogens, inhalants, tranquilizers, stimulants, or sedatives) in the past year; 2) mothers who did not use any illicit drug, but who had an alcohol use disorder in the past year; and 3) mothers who neither used illicit drugs nor had an alcohol use disorder. These exposure categories were chosen to maximize statistical power – in a sensitivity analysis, we use more restrictive exposure groups where we only consider participants who had opioid or illicit drug use disorders (see “Sensitivity Analysis”).

2.3.2. Outcome

The outcome of interest was the adolescent child's self-reported aggressive or antisocial behavior. During the survey, adolescents were asked six questions about whether, in the past year, they: 1) attacked someone with the intent to injure, 2) participated in a fight at school or work, 3) participated in a fight between groups of people, 4) carried a handgun, 5) sold drugs, or 6) stole something worth more than \$50. The primary outcome of interest was the proportion of these actions that the adolescent member of the dyad reported engaging in at least once in the past year.

2.3.3. Potential confounders

Maternal substance use and adolescent aggressive/antisocial behavior are likely to share common antecedents; as such, the crude association between these two factors would be confounded, and would not reflect a meaningful effect of maternal substance use on adolescent behavior. The following potential confounding variables are considered in this analysis – child age (continuous, 12–17), child sex (male, female), child race/ethnicity (black, white, Hispanic, other), child poverty status (continuous, in units of household income as a percent of the federal poverty line), mother's education level (less than high school, high school, some college, college), mother's marital status (married, unmarried), and number of children living in the household (0, 1, 2, 2+).

2.4. Analytic approach

For the main analysis, generalized linear models for a binomial outcome with a logit link were used to estimate the relative odds of an adolescent child's aggressive/antisocial behavior, comparing youth with a mother who misused opioids to each of the three other maternal substance use groups (see “Measures”), respectively. These models were estimated two ways – a crude model with no adjustment for confounding and a “doubly-robust” model that adjusted for confounding using both propensity score weighting and regression adjustment.

In the crude model, we regressed the proportion of antisocial behaviors reported by the adolescent child on dummy variables indicating

membership in one of the three substance use groups; no illicit drug use and no alcohol use disorder was the reference group. However, this crude odds ratio would be biased if confounding variables exist that are both associated with

mothers' substance use behavior and cause adolescent aggressive/antisocial behavior. Therefore, in our second model, we used two different methods to adjust our regression model for confounding. First, Average Treatment Effect on Treated (ATT) weights were used to re-weight the non-opioid illicit drug, alcohol use disorder, and no problem with substance use groups to have a similar distribution of confounding variables (see "Measures") to the opioid misuse group (McCaffrey et al., 2013), and the regression was fit on this weighted sample. ATT weights were computed by first estimating the probability of each mother being in each substance use group conditional on all confounding variables (see "Measures") and the respondent's survey weight (Ridgeway, 2007); this conditional probability is also known as the "propensity score." Generalized boosted models were used to estimate propensity scores (Lee et al., 2010). These predicted probabilities were then used to re-weight each observation by its odds of being in the opioid misuse group. Applying these weights yielded groups that are similar with respect to the observed potential confounders (details in Appendix A). Second, for "doubly robustness," we also used traditional regression adjustment for all covariates (McCaffrey et al., 2013).

For interpretation, exponentiated linear combinations of coefficients from regression were used to estimate the relative odds of aggressive/antisocial behavior comparing youth with mothers who misuse opioids to youth with mothers in each other group (other illicit drugs, alcohol use disorder, no problems with substance use). All outcome analyses incorporate NSDUH survey design elements such as clustering, stratification, and weighting. This means, for ATT analyses, survey weights were multiplied by ATT weights (Ridgeway, 2007). Standard errors were estimated using Taylor series linearization, and 95 % confidence intervals are presented for all estimates. Analyses were conducted using R 3.4.0, using the 'survey' package to incorporate survey design elements (Lumley, 2004), and the 'twang' package to estimate ATT weights (Burgette et al., 2016). Boosted models used for estimating the propensity scores were fit using the 'gbm' package (Ridgeway, 2007), with a maximum of 3000 trees, and predictions optimized to minimize the mean of the standardized mean differences between groups (Burgette et al., 2016).

The Johns Hopkins Bloomberg School of Public Health IRB determined this study does not qualify as human subjects research as defined by DHHS regulations 45 CFR 46.102, and therefore does not require IRB oversight.

2.5. Sensitivity analyses

We conducted two sensitivity analyses to make sure our results were robust to modeling or measurement decisions: First, we considered whether the mother member of the dyad had an OUD a more restrictive exposure than our main analyses looking at past year opioid misuse. OUD is assessed in the NSDUH using questions corresponding to the symptoms – such as withdrawal, tolerance, use in dangerous situations, or impairment of various social roles based on *Diagnostic and Statistical Manual of Mental Disorders, 4th. Edition* (DSM-IV) substance abuse or dependence criteria. An OUD is defined as meeting DSM-IV criteria for abuse or dependence on heroin or pain-relievers. In this sensitivity analysis, we compared mothers with OUD to three comparison groups: 1) mothers with an illicit drug disorder other than OUD, 2) mothers with an alcohol use disorder but no illicit drug use disorder, and 3) mothers with no substance use disorder.

Second, we repeated the analysis excluding the "sold drugs" question from the outcome definition. We did this because the effects of maternal substance use on adolescent drug selling may differ from the effects of maternal substance use on other similarly socially undesirable behaviors that do not directly involve drugs. In addition, adolescents

under certain circumstances might sell drugs to supplement family income or might be coerced into selling drugs by gang.

2.6. Human subjects

This study is not considered human subjects research because it uses de-identified data.

3. Results

Approximately 4 percent of mothers had misused opioids in the past year, 6 percent had used some other non-opioid drug illicitly in the past year, 3 percent had an alcohol use disorder but used no other illicit drugs, and the remainder did not engage in any problem substance use. Sixty-eight percent of adolescent children did not report any of the aggressive/antisocial behaviors, 19 percent reported one such behavior, and the remaining 13 percent reported two or more. Before any adjustment, adolescents whose mothers did not engage in any problematic substance use were least likely to report one or more aggressive/antisocial behaviors, followed by adolescents whose mothers had an alcohol use disorder, adolescents whose mothers used non-opioid illicit drugs, and adolescents whose mothers misused opioids. Detailed outcome frequencies and distributions of all modifying, mediating, and confounding variables are shown in Table 1.

Adolescent children whose mothers misused opioids were more likely to report aggressive/antisocial behaviors than adolescent children whose mothers did not engage in substance use (OR 1.69, 95 % CI 1.38–2.09), an association that persisted after adjusting for confounding using weights and regression adjustment (aOR 1.60, 95 % CI 1.31–1.96).

Adolescents whose mothers misused opioids also had higher odds of aggressive/antisocial behavior than adolescent children whose mothers used other illicit drugs (OR 1.23, 95 % CI 0.96–1.58; aOR 1.18, 95 % CI 0.91–1.53), and adolescent children whose mothers had an alcohol use disorder (OR 1.28, 95 % CI 0.97–1.70; aOR 1.26, 95 % CI 0.97–1.64); however, in both adjusted and unadjusted analyses these effects were smaller and not statistically significant (Table 2).

Repeating the analysis using OUD as exposure (sensitivity analysis 1), effects are very similar in magnitude, but confidence intervals are wider due to the small number of mothers who met criteria for an OUD. Repeating the analysis using the alternative measure outcome that excluded adolescent drug-selling (sensitivity analysis 2), results are very similar to the main analysis. These results are available from the authors upon request.

4. Discussion

Adolescent children growing up in a household with a mother engaged in opioid misuse exhibit elevated rates of aggressive and antisocial behaviors. This finding remains true after controlling for a number of socio-demographic factors associated with both adult substance use and adolescent delinquency. These results are consistent with our hypothesis that maternal opioid misuse could have independent, lasting adverse impacts on adolescent children's behavior.

However, the observed association – an approximately 60 % increase in the odds of aggressive/antisocial behavior as compared to adolescent children of mothers not engaged in substance use – was not statistically significantly different from the effect of other forms of maternal substance use behavior.

The prevalence of children's exposure to opioid misuse by a mother or other caregiver is likely increasing, as reflected by an increase in the number of mothers using illicit opioids during pregnancy (Patrick et al., 2012), and an increase in the number of children entering foster care which has been anecdotally attributed to an increase in the number of mothers struggling to care for their children because of opioids (Radel et al., 2018). Thus, the findings of this paper offer important context as

Table 1
Characteristics of study sample by maternal substance use group.

	Past-year maternal problem substance use ^(a)				
	Full population	No problem drug use	Opioid misuse	Other illicit drug use	Alcohol use disorder
Sample size (unweighted)	29,867	25,855	1095	2070	847
Prevalence in population (weighted)	100.0 %	87.8 %	3.6 %	5.9 %	2.7 %
Outcome					
Number of aggressive/antisocial behaviors					
0	68.4%	69.6 %	58.4 %	60.3 %	61.2 %
1	18.8 %	18.5 %	19.0 %	21.6 %	24.4 %
2+	12.8 %	12.0 %	22.6 %	18.1 %	14.4 %
Confounders					
Adolescent gender					
Male	51.6 %	51.7 %	51.7 %	49.4 %	54.5 %
Female	48.4 %	48.3 %	48.3 %	50.6 %	45.5 %
Adolescent age					
12	15.1%	15.0 %	15.0 %	17.1 %	15.3 %
13	16.3 %	16.3 %	17.2 %	16.4 %	15.6 %
14	17.4%	17.1 %	18.8 %	18.3 %	22.7 %
15	17.5 %	17.8 %	16.8 %	15.2 %	15.4 %
16	17.6 %	17.8 %	14.4 %	17.6 %	15.5 %
17	16.0 %	16.0 %	17.8 %	15.4 %	15.5 %
Adolescent race/ethnicity					
White	58.9 %	58.1 %	66.1 %	64.1 %	64.1 %
Black	14.3 %	14.3 %	10.4 %	16.4 %	13.9 %
Other	7.6 %	7.8 %	5.4 %	7.5 %	5.4 %
Hispanic	19.2 %	19.8 %	18.2 %	12.0 %	16.6 %
Adolescent poverty status					
< 100 % FPL	18.7 %	18.4 %	23.2 %	20.2 %	18.6 %
100 %–200 % FPL	21.1 %	20.9 %	23.1 %	24.4 %	16.7 %
> 200 % FPL	60.3 %	60.7 %	53.7 %	55.4 %	64.7 %
Mother education					
Less than high	14.8 %	14.7 %	19.7 %	13.3 %	16.2 %
High school	28.6 %	28.5 %	30.0 %	29.3 %	28.6 %
Some college	28.9 %	28.5 %	28.8 %	34.9 %	27.0 %
College	27.7 %	28.3 %	21.5 %	22.5 %	28.1 %
Mother's marital status					
Married	71.6 %	73.3 %	58.4 %	57.0 %	66.5 %
Unmarried	28.4 %	26.7 %	41.6 %	43.0 %	33.5 %
Number of children in household					
0 Children	0.0 %	0.0 %	0.5 %	0.0 %	0.0 %
1 Child	27.2 %	27.2 %	24.2 %	30.3 %	25.7 %
2 Children	37.8 %	37.7 %	37.0 %	38.3 %	41.6 %
3+ Children	35.0 %	35.2 %	38.2 %	31.4 %	32.7 %
Mediators					
Adolescent past-year substance use					
None	80.8 %	82.5 %	67.0 %	67.8 %	74.8 %
Opioid misuse	5.9 %	5.2 %	13.8 %	10.0 %	6.7 %
Other illicit drug use	12.4 %	11.4 %	18.4 %	21.6 %	17.1 %
Alcohol use	0.9 %	0.9 %	0.8%	0.6 %	1.4 %

^a Mutually exclusive categories constructed as follows: any opioid misuse, any use of an illicit drug other than opioids, any alcohol use disorder but no use of any other illicit drugs, none of the above.

the United States considers appropriate responses to its worsening crisis of opioid-related harms. Specifically, they suggest that mothers' misuse of opioids is a cause for concern among adolescents and that the public response to the opioid crisis must address not only the needs of adults who misuse opioids, but also their dependent children.

Table 2
Relative odds of aggressive/antisocial behavior in adolescent children with mothers who misused opioids.

	Reference parent substance use group		
	No problem Substance use	Other illicit Drug use	Alcohol use Disorder
No confounding adjustment	1.69 [1.38–2.09]	1.23 [0.96–1.58]	1.28 [0.97–1.70]
Doubly Robust ^a	1.60 [1.31–1.96]	1.18 [0.91–1.53]	1.26 [0.97–1.64]

^a Adjusted – using propensity score weighting and regression adjustment – for child's age, sex, race/ethnicity, and poverty status; parents' education level and marital status; and number of children in the household.

There are a number of potentially promising policy and programmatic approaches to improving outcomes for children of parents who misuse opioids. One is evidence-based parenting programs for children of parents with substance use disorders. There are relatively few parenting programs for parents with substance use disorders, and many other well-supported parenting programs have not yet been validated for parents with substance use disorder (Barth, 2009; Renk et al., 2015). However, a review of programs for parents with substance use disorder found that some – those that simultaneously provide treatment to parents for their substance use disorder and provide parent training/therapies – reduce substance use and improve outcomes for children and adolescents (Neger and Prinz, 2015). Promising new programs are also currently being developed (Schaeffer et al., 2013).

In addition to programs that target parenting directly, simply increasing parents' utilization of evidence based treatment for potentially harmful opioid use would likely have ancillary benefits for their children. Specifically, medication-assisted treatments are the best-supported treatments for opioid use disorder (Volkow et al., 2014). These treatments have long been the standard of care for pregnant women, because they improve birth outcomes (Heberlein et al., 2012; Wong et al., 2011), which may have lasting behavioral benefits into later childhood and adolescence (Indredavik et al., 2010; Talge et al., 2010). There is also evidence these treatments can help parents whose caregiving ability is impaired by opioid misuse regain their capacity to care for their children (Hall et al., 2016). However, there are not enough providers of medication-assisted treatment available to meet current need in the United States (Christie et al., 2020), and transportation and lack of childcare often impose additional important barriers to parents receiving substance use treatment (Neger and Prinz, 2015), policies may be needed to help alleviate these barriers.

This study has a number of limitations. First, with a cross-sectional dataset, we cannot conclude that mothers' opioid misuse was the cause of their adolescent children's behavior. It is possible, although unlikely, that children's behavior was the cause of mother's misuse of opioids. It is also possible that there exists some unmeasured confounding variable that is the common cause of maternal opioid misuse and adolescent behavior, for example a shared underlying genetic risk, or residual confounding by socioeconomic status not fully captured by our control variables. Future research should examine the effect of randomized or quasi-randomized interventions on parents' substance use and explore the impact on adolescent outcomes. Second, this study only captures dyads of mothers and children residing in the same household. Many children of mothers who misuse opioids may not live with their mothers, and we might expect the association of mothers' misuse of opioids with their adolescent children's behavior to be different when they do not live together. Third, in this cross-sectional study, we cannot determine the mechanism by which maternal misuse of opioids impacts adolescent behavior, whether through impaired parenting, past effects of use during pregnancy, or some other reason. Fourth, we do not know if any members of the household other than the surveyed parent are

using opioids or other substances.

5. Conclusion

Our findings provide evidence that mothers' opioid misuse is independently associated with elevated aggressive or antisocial behavior in their adolescent children, and this association is similar to that seen for other problematic maternal substance use behaviors. These findings imply that the adverse consequences of the ongoing opioid crisis are not confined to adults who misuse opioids. To avert lasting harm, a comprehensive public health response to the opioid crisis must serve not only opioid misusers, but also the needs of their children.

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Contributors

Dr. Feder conducted analyses and drafted the manuscript. Drs. Ali,

Sherman, and Mutter assisted in the analyses, and edited and revised manuscript drafts. Drs. Barry, Stuart, and Letourneau assisted in design of the study, and reviewed manuscript drafts. All authors contributed to the development of the research question, planning of the analysis, and revising the manuscript. All authors have approved the final article.

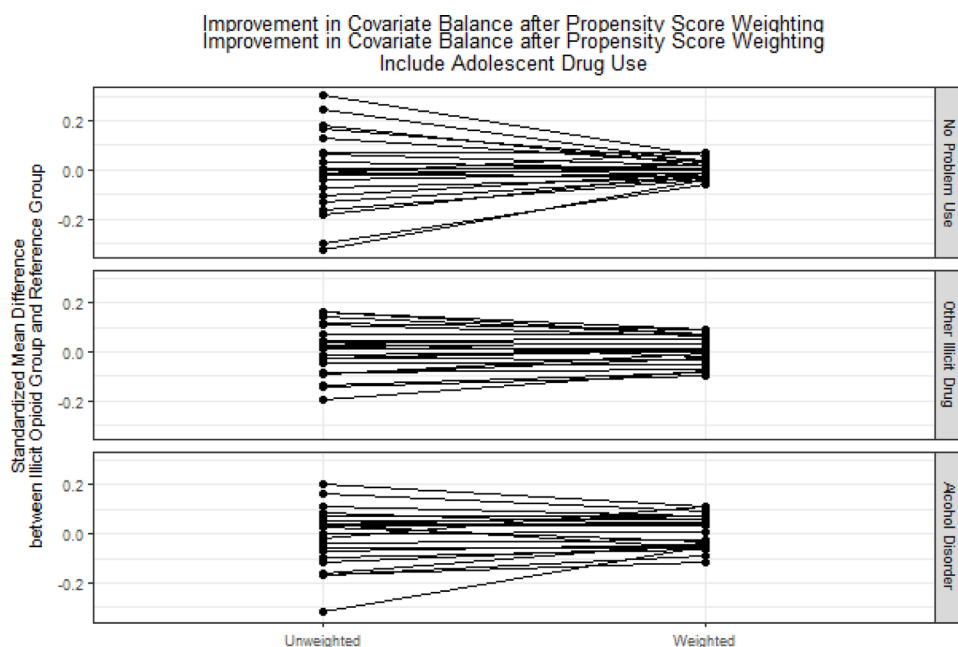
Conflicts of interest

The authors have no conflicts of interest to disclose.

Disclaimer

This paper has not been subject to the Congressional Budget Office's regular review and editing process. The content is solely the responsibility of the authors and does not necessarily represent the official views of the Congressional Budget Office, Office of the Assistant Secretary for Planning and Evaluation or the US Department of Health and Human Services.

Appendix A. Balance metrics from propensity score match



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