



Prescription opioid use disorder and heroin use among 12–34 year-olds in the United States from 2002 to 2014



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HIGHLIGHTS

- Trends analyses were done in U.S. nonmedical prescription opioid users.
- From 2002 to 14, opioid disorder increased in NMPO users ages 18–34.
- Trends in heroin use increased significantly in 18–34 NMPO users.
- There was no change in opioid use disorder or heroin use among NMPO users ages 12–17.
- Results call to action to stop these rising trends among NMPO youth.

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1. Introduction

Trend analyses of prescription opioids in the U.S. indicate use, especially use of prescription opioids stronger than morphine, has more than doubled among adults since the early 1990's (Frenk, Porter, & Paulozzi, 2015). Prescription opioids, like Oxycontin®, are effective pharmacological treatments for acute and chronic pain (Fitzcharles & Shir, 2009;

Gallagher & Rosenthal, 2008). When used as indicated, these medications can be an important component of pain management. However, their high abuse potential presents concerns regarding their nonmedical use, which can be defined as 'use of a prescription opioid that was not prescribed, or taken for the experience or feeling it caused' (SAMHSA, 2014). In the United States, nonmedical use of prescription opioids (NMPO) is increasingly recognized as a serious public health problem among adults (Blanco et al., 2007; Han, Compton, Jones, & Cai, 2015; Huang et al., 2006). Nonmedical prescription drug use, specifically nonmedical use of prescription opioids, is also a growing problem in other countries such as Canada (Fischer, Gooch, Goldman, Kurdyak, & Rehm, 2014; Fischer, Ialomiteanu, Kurdyak, Mann, & Rehm, 2013) and Australia (Degenhardt et al., 2006; Rintoul, Dobbin, Drummer, & Ozanne-Smith, 2011).

Repeated NMPO use increases the risk of developing an opioid use disorder. Studies have shown that adults using prescription opioids as prescribed by a doctor to treat chronic pain are less likely to develop DSM-IV dependence (Minozzi, Amato, & Davoli, 2013) compared to nonmedical opioid users (Compton, Dawson, Goldstein, & Grant, 2013; Huang et al., 2006; Peer et al., 2013; SAMHSA, 2009). Thus, it is important to detect NMPO use early before clinical problems emerge. Nearly 80% of 12–21 year olds who reported initiation of heroin use had previously initiated NMPO between the ages 13–18 (Cerdá, Santaella, Marshall, Kim, & Martins, 2015). In general household population samples of past-year NMPO users in the U.S., approximately 7% and 9% of adolescents met criteria for prescription opioid abuse and

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dependence, respectively (Wu, Blazer, Li, & Woody, 2011), and 11% of the past-year NMPO users between ages 18–34 met criteria for prescription opioid use disorder (Becker, Sullivan, Tetrault, Desai, & Fiellin, 2008).

Given this and the high probability of nonmedical use among adolescents and young adults, the potential development of prescription opioid use disorder secondary to nonmedical use among youth represents an important and growing public health concern. Still, no study has investigated time trends, specifically if prescription opioid use disorder has increased in the past decade among adolescents, emerging adults and young adults who are nonmedical users of prescription opioids.

Heavy use of prescription opioids can affect neurodevelopment during critical periods from in utero through adolescence and into young adulthood (Chambers, Taylor, & Potenza, 2003; Uebel et al., 2015). Data from Monitoring the Future (MTF) have shown that late high school (12th grade) medical PO use is associated with adult onset of NMPO use (Miech, Johnston, O'Malley, Keyes, & Heard, 2015), while other MTF research has shown declining NMPO use into young adulthood after NMPO use in high school (McCabe, Schulenberg, O'Malley et al., 2014). Further, opioid use disorders can impact all aspects of adolescents' and young adults' lives, including family, school, and the acquisition of adult roles and responsibilities (Boyd, McCabe, & Teter, 2006; Wu et al., 2011; Wu, Ringwalt, Mannelli, & Patkar, 2008). Despite research findings that young adulthood is a period of high vulnerability to drug effects (Hwang et al., 2013), adolescent susceptibility to drug effects might be even greater due to adolescent physiological and social transitions (Rudolph, Lambert, Clark, & Kurlakowsky, 2001). Thus, it is important to examine patterns of prescription opioid use disorder in different developmental periods including adolescence, the transition from adolescence to adulthood and early adulthood.

In addition, previous studies have shown that NMPO use is a risk factor for subsequent heroin use (Becker et al., 2008; Compton, Jones, & Baldwin, 2016; Fogger & McGuinness, 2015; Jones, 2013; SAMHSA, 2011). This is of particular concern given that, in the U.S., the number of individuals aged 18–25 with past-year heroin dependence has almost doubled between 2002–2005 and 2009–2011 (SAMHSA, 2012a). Also, the number of adolescents that are dependent on heroin increased significantly by >50% (from 8000 to 13,000) (SAMHSA, 2012a). Previous research has also found an increased use of heroin among youth that have initiated using prescription opioids nonmedically early in their adolescence, with a peak period of heroin initiation at age 17–18 (Cerdeira, Santaella, Marshall, Kim & Martins, 2015).

Using U.S. nationally representative population-based data (2002 to 2014) on adolescents (12–17 years), emerging adults (18–25 years) and young adults (26–34 years), we sought to answer the following research questions: 1) Were there significant changes between 2002 and 2014 in past-year prescription opioid use disorder secondary to NMPO use among those who were nonmedical PO users? 2) Were there significant changes between 2002 and 2014 in past-year heroin use among individuals who were NMPO users? Examining changes in prescription opioid use disorder secondary to prescription opioid use over time and heroin use among NMPO users is important for informing policies related to prescription opioid use as well as evidence-based prevention and treatment strategies (NSDUH, 2016). A closer look at earlier critical developmental periods— in particular adolescence and young adulthood —is warranted if we want to curb the increasing morbidity and mortality associated with NMPO use.

2. Materials and methods

2.1. Sample

Data were derived from the 2002 to 2014 National Survey on Drug Use and Health (NSDUH) specifically focusing on youth who were NMPO users: 12–17 years old (N = 15,308), 18–25 years old (N =

25,751), and 26–34 years old (N = 5121). The NSDUH is sponsored by the Substance Abuse and Mental Health Administration (SAMHSA) and is designed to provide annual prevalence estimates of nonmedical use of legal and illegal drugs in the household population 12 years of age and older in the United States (SAMHSA, 2012a). The survey employs a 50 state design with an independent multistage area probability sample for each state and the District of Columbia and oversamples younger age groups (aged 12–25) as well as African-Americans and Hispanics. Response rates varied between 81.94 and 91.00% for weighted screening response rate, and between 71.2 and 79.00%, for weighted interview response rate. Interviews were administered by a trained interviewer using computer-assisted personal interviewing (CAPI). Drug sections were administered more privately using audio computer-assisted self-interviewing (ACASI) to increase the level of honest reporting of illegal drug use and other sensitive behaviors (Morrill, McCaffrey, & Chien, 2003). Participants were offered a \$30 incentive. Detailed information about the sampling and survey methodology of NSDUH can be found elsewhere (SAMHSA, 2012a).

2.2. Measures

2.2.1. Past-year nonmedical use of prescription opioids

The survey includes a stem question that first determines if NMPO use occurred: “These questions are about prescription pain reliever use. We are not interested in your use of over-the-counter pain relievers that can be bought in stores without a doctor's prescription.” Participants endorsed if they had used any NMPO in the past-year by answering: “how long has it been since you last used any prescription pain reliever that was not prescribed for you or that you took only for the experience or feeling it caused” (SAMHSA, 2012a). To improve the quality of reporting, participants were given a card with names of prescription opioids (non-opioid medications are not included). Respondents were asked a series of follow-ups question on specific drugs included in this class.

2.2.2. Past-year heroin use

Participants were asked if they had used heroin during the past 12 months. Individuals were classified as past-year heroin users if they endorsed using heroin at least once during the previous 12 months.

2.2.3. Prescription opioid use disorder

Information on past-year prescription opioid abuse and dependence was obtained from a set of structured questions based on criteria for substance disorders from the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) (American Psychiatric Association, 2000). The NSDUH provides a summary variable for prescription opioid use disorder based on whether the respondent endorsed 1 of the 4 abuse questions and/or 3 of the 7 dependence questions. Probable disorder diagnosis based on these questions has been found to have good agreement with clinical judgement (Jordan, Karg, Batts, Epstein, & Wiesen, 2008).

2.2.4. Covariates

The covariates considered for adjustment were the respondents' sex, race/ethnicity (Whites, Blacks, Hispanics, Asians, and Other race/ethnicity), and calendar year of interview (2002–2014).

2.3. Data analyses

Data were analyzed using STATA 13.0 (STATA, 2013). Weights were included to reflect the complex design of the NSDUH/NHSDA sample. We used Taylor series linearization estimation methods (Stata 'svy' commands) to obtain standard errors for the cross-tabulations Past-year PO use disorder and past-year heroin use were our two main outcomes. First, we estimated the yearly increase in the odds ratio of past-year PO use disorder and heroin use among NMPO users, over time

(2002 to 2014), using weighted logistic regression analyses adjusted for demographics (sex, race/ethnicity). Then, separately, we estimated the yearly prevalence of PO use disorder and heroin use by adjusting weighted linear regression models. We calculated the yearly trend (p-value for trend) by including year as a continuous variable in separate linear regression models.

3. Results

Among past-year NMPO users (aged 12–34 years), the majority of the respondents were Whites (70.80% vs. Blacks = 9.61%, Hispanics = 14.65%, Asians = 2.05% and other race/ethnic group = 2.89%). There were slightly more males than females (55.05% vs. 44.95%). Overall, the past-year prevalence of NMPO use significantly decreased from 2002 to 2014 among adolescents (7.51% to 4.82%, p-value for trend < 0.05), among emerging adults ages 18–25 (11.43% to 7.59%, p-value for trend < 0.05), and among young adults ages 26–34 (6.18% to 6.08%, p-value for trend < 0.05). Compared to 2002, the yearly prevalence of NMPO use in 2014 decreased 37% in adolescents (aOR = 0.63; 95%CI = 0.56–0.71), 34% in emerging adults (aOR = 0.66; 95%CI = 0.60–0.73), and remained unchanged in young adults (aOR = 1.00; 95%CI = 0.81–1.23).

3.1. Prescription opioid use disorder among NMPO users: Changes in past-year prevalence

Fig. 1 illustrates the prevalence of prescription opioid use disorder among NMPO users from 2002 to 2014. The prevalence of prescription opioid use disorder significantly increased among emerging adults aged 18–25 (11.98% to 15.11%, p-value for trend < 0.05, aOR = 1.37; 95%CI = 1.03–1.81), and likewise from 2002 to 2014 among young adults aged 26–34 (11.27% to 23.52%, p-value for trend < 0.05, aOR = 2.43; 95%CI = 1.56–3.78). Overall, during the study period, the difference in prescription opioid use disorder prevalence among NMPO users from 2002 to 2014 was 1.41% in adolescents, 3.13% in emerging adults and 12.25% in young adults (Fig. 2). Among adolescents (12–17 years), the prevalence of prescription opioid use disorder remained relatively stable during the same period (Appendix A: Supplemental Table 1). From 2002 to 2010 no significant trends were observed; from 2011 until 2014, emerging and young adults had a significantly higher prevalence of prescription opioid use disorder compared to adolescents (17.65%, aOR = 1.62, 95%CI = 1.29–2.05; 17.32%, aOR = 1.66, 95%CI = 1.01–2.72; 16.36%, aOR = 1.41, 95%CI = 1.05–1.90; respectively) (Appendix A: Supplemental Table 1).

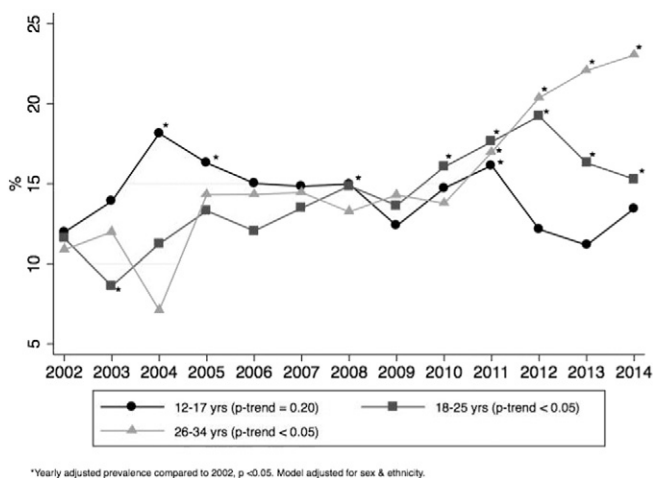


Fig. 1. Adjusted prevalence of prescription opioid use disorder among past-year nonmedically prescription opioids users, stratified by age, in the U.S. household population.

3.2. Heroin use among NMPO users: changes in past-year prevalence over time

Fig. 3 shows past-year heroin use among past-year NMPO users, and we can see an increasing trend from 2002 to 2014 among emerging adults (2.11% to 7.35%, p-trend < 0.05) and young adults (1.62% to 12.29%, p-trend < 0.05). There is only a slight and non-significant increase in past-year heroin use among adolescents who were also NMPO users (1.80% to 2.30%, p-trend = 0.17, see Appendix A: Supplemental Table 2). The difference in the prevalence of heroin use among NMPO users from 2002 to 2014 was 0.5%, 5.24% and 10.67% among adolescents, emerging adults and young adults, respectively (Fig. 4). Overall, the prevalence of past-year heroin use among NMPO users increased four-fold in emerging adults (aOR = 4.18; 95%CI = 2.59–6.73) and nine-fold in young adults (aOR = 9.09; 95%CI = 2.96–27.95). Across the study period, the increment in past-year heroin use is more dramatically observed from 2012 onwards among emerging and young adults (see Appendix A: Supplemental Table 2; aOR = 3.57; 95%CI = 2.24–5.70, and aOR = 3.61; 95%CI = 1.05–12.42, respectively).

4. Discussion

The main findings of this study can be described as follows: 1) there was an increase in the probability of having a prescription opioid use disorder in the past year among 18–34 year old NMPO users (compared to 2002, in 2014 there was a 37% increase in the odds of having a disorder for emerging adults and a doubling of the odds among young adults); 2) there was a four-fold and nine-fold increase over time in the odds of heroin use among emerging adults and young adults who were NMPO users, respectively; and 3) there were no significant changes prescription opioid use disorder secondary to NMPO use or heroin use among adolescent users.

Our study's findings parallel the public health concern on the rise of prescription opioid and heroin overdoses and mortality (Ballantyne & Kolodny, 2015; CDC, 2012). To our knowledge, this is the first national study to analyze the time trends of prescription opioid use disorder and heroin use among NMPO users on a yearly basis among adolescents and emerging and young adults over a twelve-year time period. NMPO use is a common growing public health problem that is not limited to the United States; prescription opioid consumption doubled from 2004–2006 to 2010–2011 in the general population in Ontario, Canada (Fischer et al., 2014). Similarly, Australia's general population experienced a 15-fold increase in NMPO, from 1992 to 2012 (Blanch, Pearson, & Haber, 2014). Research from different countries push forward a similar conclusion: there are important gaps in knowledge in prescription opioid use and, more specifically, in NMPO use to compute the health impact and inform interventions.

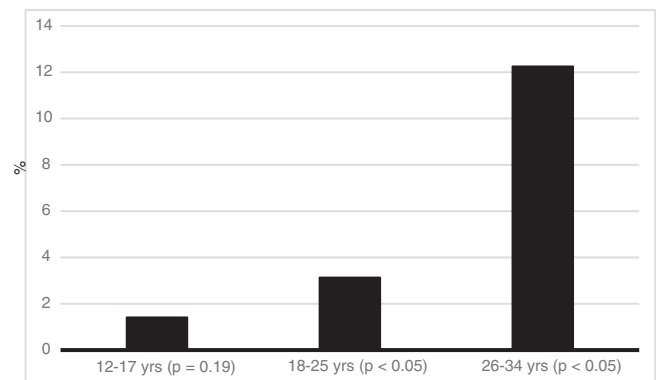


Fig. 2. Average change in the prevalence of prescription opioid use disorder, from 2002 to 2014, among NMPO users by age groups.

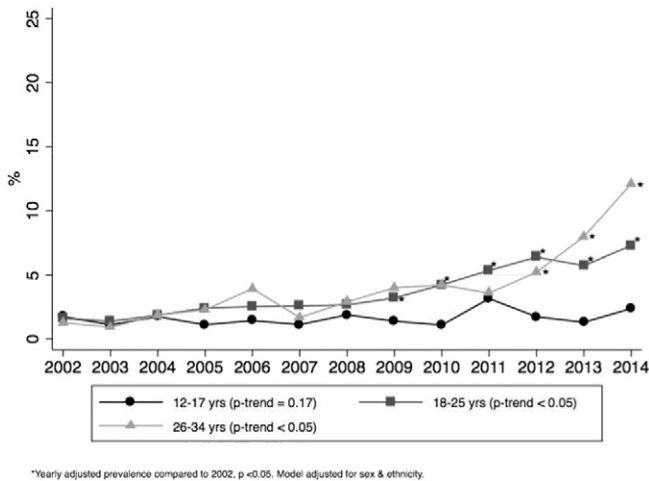


Fig. 3. Adjusted prevalence of heroin use among NMPO users in the U.S. household population (2002–14).

Moreover, our results show that trends of NMPO use in recent years, after 2008, among the U.S. general population are declining. This finding is in contrast with increases seen in the general U.S. population before 2007 according to national representative data (SAMHSA, 2008), and data from the Research Abuse, Diversion and Addiction-Related Surveillance (RADARS) System Poison Centers Program in the US that showed a linear increase in NMPO in adults aged 20 to 59 years between 2006 and 2013 (West, Severtson, Green, & Dart, 2015). Declines in NMPO use in the same period (2003–2014) have been seen among adolescents in the NSDUH after the year 2008 (Vaughn, Nelson, Salas-Wright, Qian, & Schootman, 2016), and in other datasets such as the Monitoring the Future (MTF), where declines after the same year (2008) in prescription opioid use (like Vicodin® and Oxycontin®) among 12th graders, college students and young adults were reported (Miech, Johnston, O'Malley, Bachman, Schulenberg, & Patrick, 2015). Similarly, McCabe et al. reported declines in NMPO use among U.S. college students in the Midwest from 2003 to 2013 (McCabe, West, Teter, & Boyd, 2014). Our study not only expands the analyses of this trend by investigating prescription opioid use disorder secondary to use in across a 13-year span, but adds two important findings: 1) an increasing trend of this disorder found among young adult users aged 18–35; and 2) a parallel increasing trend in heroin use among NMPO users in the same age range.

Previous research in U.S. population 12 years and older, using NSDUH data, supports the relationship between prescription opioid and heroin use; an increase in heroin use was found among those reporting NMPO use between 2002–2005 and 2008–2011 (Martins, Santaella-Tenorio, Marshall, Maldonado, & Cerda, 2015). However, a

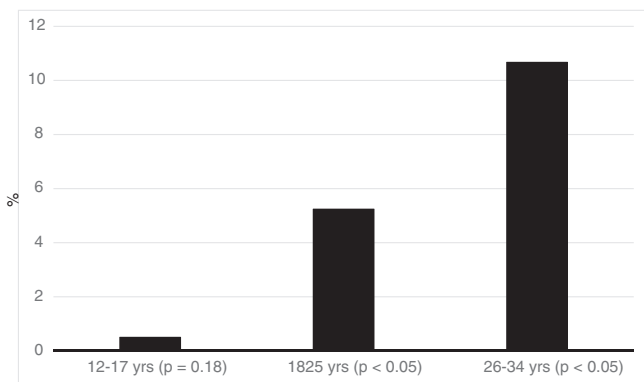


Fig. 4. Total percentage change from 2002 to 2014 in heroin use prevalence among NMPO users, in the U.S. household population, by age groups.

separate analysis showed that 3.6% of NMPO users initiate heroin within five years of NMPO initiation and 4.2% of NMPO users also used heroin in the past-year (Compton et al., 2016). Our study is in accordance with past research (Blanco et al., 2007), as we found a worrisome increasing trend in heroin use among NMPO users, in particular in 18–34 year olds.

Although our study does not assess underlying causes, the increasing trend in prescription opioid use disorder observed in young adults might be at least partially explained by historical factors described elsewhere in the literature, such as: a shift in medical practice of prescribing opioids from end-of-life pain and cancer to chronic non-cancer pain, particularly in young adults (Franklin et al., 2015); an increased rate of opioid prescription by physicians due to a higher sensitivity to patient's pain (CDC, 2012); the endorsement of pain as a “fifth vital sign” by the Joint Commission with a controverted pain metric (Franklin et al., 2015); an increased distribution of opioids by the pharmaceutical industry and creation of an opioid rich environment (Rintoul & Dobbin, 2014); state lobbying by pain advocates for prescription opioids use; physician sensitivity to pain exploitation by opioid users; as well as “doctor shopping” by patients (Ballantyne & Kolodny, 2015; CDC, 2012; Shepherd, 2014) and overprescribing (Compton et al., 2016), which leaves excess medications available for misuse or redistribution via nonmedical sanctioned venues. In addition, Friedman suggests that positive media attention, which fosters an image that prescription drug use is a routine aspect of everyday life, together with an increase in the pharmaceutical industry expenditures in direct-to-consumer advertising, has led to growing confidence in the safety of using prescription drugs nonmedically (i.e., “normalization” of nonmedical use of these drugs) (Friedman, 2006). This could be worrisome given normalization of attitudes and behaviors upon exposure to mass media, especially among impressionable youths (Montgomery, 2000).

Our study is not void of limitations including the fact that weights from the 2002–2010 NSDUH were calculated using the 2000 U.S. census data, while the 2011–2014 weights were based on 2010 census data. Although this might have slightly affected the comparability of estimates across years, evidence shows that the impact of this change on estimates are not substantial (SAMHSA, 2012a). Moreover, as in most large-scale epidemiologic surveys, information is based on self-report, and there might be recall bias in reporting both drug use and other sensitive behaviors (Morrall et al., 2003), keeping in mind that our study was limited to use, and use disorder in the preceding year at each year. Still, respondents might under-report prescription opioid use disorder symptoms and their use of heroin which is a drug that has more stigma associated with it. Also, data to distinguish whether these NMPO users first started using these drugs when legitimately prescribed (e.g., pain relief) or when obtained illegally (i.e., to get high) are still unavailable in the NSDUH. Similarly, with the data used in this paper we cannot make real inferences on whether NMPO use preceded heroin use onset due to the cross-sectional nature of the annual NSDUH and the limited availability on data on age of onset (available only for respondents up to age 21). However, data on age of first use for heroin and NMPO is available in the NSDUH data sets. We ran post-hoc analyses among those that endorsed using NMPO and found that, among the three age groups, the vast majority had started using heroin after starting NMPO use. Specifically, 52.98% of those 12–17 years old, 78.51% of those 18–24 years old, and 69.16% of those 25–34 years old had higher age of onset for heroin use than for NMPO use (see Supplemental Table 3).

5. Conclusion

In conclusion, between 2002 and 2014, prescription opioid-related use disorders secondary to nonmedical use and heroin use among NMPO users increased among emerging and young adults. Although our descriptive analyses do not address the potential causes in the rise of these trends, it seeks to present the evidence in order to raise awareness and urgency to address these rising and problematic trends among

youth. There is some evidence that increases in prescription opioid use disorder secondary to NMPO use might be rooted in health policy, medical practice, pharmaceutical industry interests and patient behavior (Belcher et al., 2014). While pain management is an important feature in the medical conversation and practice when patients are prescribed prescription opioids (Dowell, Haegerich, & Chou, 2016), it is imperative that the general public, particularly youth, are informed about the related harms and disorders that can occur when prescription opioids are used without regular medical supervision.

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Contributors

All authors have contributed significantly to the work and agree with the submission. Dr. Martins designed the study, directed Dr. Luis Segura and Dr. Santaella-Tenorio on the data analyses, and wrote the first full draft of the manuscript with their assistance. Drs. Segura and Mr. Alexander Perlmutter conducted the literature review, Dr. Santaella-Tenorio prepared the Methods sections of the text and Dr. Segura drafted the final version of the Results section. Dr. Miriam C. Fenton, Dr. Magdalena Cerdá, Dr. Katherine M. Keyes, Dr. Lilian A. Ghandour, Dr. Carla L. Storr, and Dr. Deborah S. Hasin critically reviewed and edited all sections of the manuscript.

Conflict of interest

Dr. Hasin is Principal Investigator of a study on a measure of addiction to prescription opioids funded by InVention Health Consulting, which combines support from nine pharmaceutical companies. All other authors have no conflict of interest to declare.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.addbeh.2016.08.033>.

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