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Does early onset of non-medical use of prescription drugs predict subsequent prescription drug abuse and dependence? Results from a national study

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Abstract

Aims—The present study examined the associations between early onset of non-medical use of prescription drugs (NMUPD) (i.e. sedatives, tranquilizers, opioids, stimulants) and the development of prescription drug abuse and dependence in the United States.

Design—Data were collected from structured diagnostic interviews using the National Institute on Alcohol Abuse and Alcoholism (NIAAA) Alcohol Use Disorder and Associated Disabilities Interview Schedule: *Diagnostic and Statistical Manual* version IV (DSM-IV).

Setting—National prevalence estimates were derived from the 2001–2002 National Epidemiologic Survey on Alcohol and Related Conditions (NESARC, $n = 43\,093$).

Participants—A nationally representative cross-sectional sample of civilian non-institutionalized adults aged 18 years or older in the United States, of whom 52% were women, 71% white, 12% Hispanic, 11% African American, 4% Asian and 2% Native American or of other racial background.

Findings—A higher percentage of individuals who began using prescription drugs non-medically at or before 13 years of age were found to have developed prescription drug abuse and dependence versus those individuals who began using at or after 21 years of age. Multivariate logistic regression analyses indicated that the odds of developing any life-time prescription drug abuse among non-medical users was reduced by approximately 5% with each year non-medical use was delayed [adjusted odds ratio (AOR) = 0.95, 95% CI = 0.94, 0.97], and that the odds of developing any life-time prescription drug dependence were reduced by about 2% with each year onset was delayed (AOR = 0.98, 95% CI = 0.96, 1.00) when controlling for relevant covariates.

Conclusions—The results of this study indicate that early onset of NMUPD was a significant predictor of prescription drug abuse and dependence. These findings reinforce the importance of developing prevention efforts to reduce NMUPD and diversion of prescription drugs among children and adolescents.

Keywords

DSM-IV drug use disorders; non-medical use; prescription drug abuse; prescription drug dependence; prescription drug initiation

INTRODUCTION

The initiation of substance use involves initial exposure to and experimentation with a drug. In general, alcohol and tobacco are the first psychoactive drugs with which young people experiment, and use of these substances precedes use of marijuana and other drugs [1]. Early initiation of substance use is especially important because of its consistent association with increased risk of the development of alcohol and other drug-related problems [2–5].

There has been an increase in the non-medical use of prescription drugs (NMUPD) in the United States over the past 15 years [6–8]. In 2004, approximately 2.4 million Americans aged 12 years or older initiated non-medical use of prescription opioids within the past year, which exceeded the numbers of initiates for marijuana (2.1 million) or cocaine (1.0 million) [9]. Despite recent increases in NMUPD, there is a gap in knowledge regarding the association between early onset of NMUPD and the development of prescription drug abuse and dependence in the United States.

Previous research has shown that individuals who begin drinking before age 15 are more likely to develop DSM-IV alcohol abuse and dependence in their life-time than those who begin drinking at age 21 [3]. Similarly, early onset of marijuana and other drug use is a significant risk factor for the subsequent development of drug-related problems and drug use disorders (DUDs) [2,4,10]. However, relatively little is known about the epidemiology of prescription drug abuse and dependence compared to alcohol use disorders (AUDs) and other DUDs. Previous studies have often combined prescription drugs and illicit drugs (e.g. sedatives, tranquilizers, opioids other than heroin and stimulants, cocaine, cannabis, heroin, hallucinogens and inhalants) when examining the associations between age at onset and subsequent development of DUDs. As a result, existing findings are limited with respect to the age at onset of NMUPD and its implications. To date, no studies have examined the probability of life-time prescription drug abuse and dependence as a function of age at onset of NMUPD. Such information would be helpful in planning assessment, prevention and intervention efforts to address prescription drug abuse and dependence. The purpose of the present study was to examine the relationship between the age at onset of NMUPD (i.e. sedatives, tranquilizers, opioids, stimulants) and prevalence of lifetime prescription drug abuse and dependence in a large nationally representative sample of US adults.

METHODS

The present study used data from the 2001–2002 National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), which included the National Institute on Alcohol and Alcoholism (NIAAA) Alcohol Use Disorder and Associated Disabilities Interview Schedule-DSM-IV version (AUDADIS-IV), a fully structured diagnostic interview. The AUDADIS-IV was computerized and interviewer-administered with responses entered directly into laptop computers. The target population for the NESARC was the civilian non-institutionalized population ages 18 and older and residing in the United States. The overall response rate for the NESARC was 81%; the household response rate was 89%, and the person response rate was 93%. Additional information regarding sampling procedures and response rates are described in more detail elsewhere [11].

Sample

The NESARC sample ($n = 43\,093$) included people living in households, military personnel living off base and people residing in the following group quarters: boarding or rooming houses, non-transient hotels, shelters, facilities for housing workers, college quarters and group homes. The sample consisted of approximately 52% women, 71% whites, 12% Hispanics, 11% African

Americans, 4% Asians and 2% Native Americans or other racial categories. The age range of the sample was 18–98 years of age. Twelve per cent of the sample was 18–24 years of age, 39% was 25–44 years of age, 30% was 45–64 years of age and 19% was 65 years and older.

Measures

The measures in the NESARC survey assessed demographic characteristics and a wide range of drug use behaviors, including alcohol use, NMUPD and patterns of drug abuse and dependence. Many of these substance use items are known to be valid and reliable for population-based research [12–18].

NMUPD—NMUPD was assessed for each of the following classes of prescription medications separately: sedatives (e.g. sleeping pills, Seconal, Quaaludes); tranquilizers or anti-anxiety drugs (e.g. Valium, Librium, Xanax); opioids (e.g. Codeine, Darvon, Percodan, Dilaudid, Demerol); and stimulants (e.g. Preludin, Benzedrine). A more extensive list of specific prescription drugs within each category is available elsewhere [19]. Respondents were asked to consider life-time non-medical use of prescription drugs that were not prescribed to them by a doctor or used in a manner not intended by the prescribing clinician (e.g. more often than prescribed, longer than prescribed or for a reason other than prescribed, such as to get high). Previous research has established the reliability and validity of similar drug use measures [17,18,20].

Age at onset of NMUPD—Age at onset of NMUPD was measured by asking respondents how old they were when they first used a drug. Separate questions were asked for each prescription drug category and respondents were asked to specify their age at onset in years. The test–retest reliability coefficients (kappas) associated with age at onset were $\kappa = 0.69$ for sedatives and $\kappa = 0.92$ or higher for tranquilizers, opioids and stimulants [12]. Four variables indicating age at onset for non-medical users of each class of prescription drugs were created, and a variable indicating age at onset of first non-medical use of any prescription drug was also generated.

DUD—DUD diagnoses involving prescription drugs were made using the AUDADIS-IV, which contains symptom questions that operationalize DSM-IV criteria for drug use disorders, including drug-specific diagnoses for each of the four classes of prescription drugs (i.e. sedatives, tranquilizers, opioids, stimulants). Consistent with the DSM-IV, a life-time AUDADIS-IV diagnosis of prescription drug abuse required at least one positive response to four criteria defined for abuse in either the 12-month period preceding the interview or during a previous 12-month period, and the absence of a dependence diagnosis. A life-time AUDADIS-IV diagnosis of prescription drug dependence was defined as a positive response to at least three of the seven dependence criteria in either the 12-month period preceding the interview or during a previous 12-month period. The test–retest reliability coefficients (kappas) associated with DSM-IV, AUDADIS-IV diagnoses of prescription drug use disorders have ranged from $\kappa = 0.69$ – 0.96 in other studies, and the validity of the diagnoses has been established several times previously [12–16,21–24]. Binary outcome variables were created for life-time prescription drug abuse and dependence outcomes involving each class of prescription drugs (in addition to indicators of any prescription drug abuse or dependence, considering the four classes of prescription drugs).

Family history of alcoholism—Family history of alcoholism was assessed by asking respondents whether any of their first-degree biological relatives (including fathers, mothers, brothers or sisters) who were at least 10 years of age were ever alcoholics or problem drinkers. The test–retest reliability coefficients (kappas) associated with the family history items were $\kappa = 0.72$ for fathers, $\kappa = 1.00$ for mothers, $\kappa = 0.90$ for brothers and $\kappa = 0.73$ for sisters based

on previous work [4]. A binary indicator of family alcohol history was created indicating whether any first-degree relatives were ever alcoholics or problem drinkers.

Age at onset of alcohol use—Age at onset of alcohol use was measured by asking respondents how old they were when they first started drinking, not counting small tastes or sips of alcohol. Dawson and colleagues [25] reported an intraclass correlation coefficient of 0.72 for this item based on a test–retest study conducted in conjunction with the National Longitudinal Alcohol Epidemiologic Survey.

Data analysis

Individuals living in households and group quarters were assigned sampling weights reflecting the products of the inverses of their probabilities of selection at each stage of the NESARC sample design. These weights were adjusted to account for non-response, and a poststratification adjustment factor was also incorporated to ensure that weighted NESARC estimates would be representative of the target population within cells determined by age, gender and race/ethnicity [26]. The standard procedure for design-based analysis of weighted and clustered survey data is to use a statistical software package (e.g. SUDAAN) that takes the complex sample design into account when calculating parameter estimates and standard errors. In this study, the method of Taylor series linearization was used to estimate all standard errors and the MISSUNIT option was utilized in SUDAAN to calculate variances within NESARC design strata with only one primary sampling unit. Methods appropriate for sub-population analyses [27] were also utilized in this study, when applicable.

To examine whether earlier initiation of NMUPD leads to a greater likelihood of developing prescription drug abuse or prescription drug dependence, life-time users of sedatives, tranquilizers, opioids and stimulants with non-missing ages of onset for any given class of drugs were grouped into nine age-at-onset categories (ranging from 13 and below to 21 and above) based on previous research [4]. Weighted estimates of the proportions of users within each age at onset group for a given class of prescription drugs who developed either abuse of or dependence on that drug class were then calculated, in addition to 95% design-based confidence intervals for the proportions. Bivariate associations between the age groups and development of prescription drug abuse or dependence were assessed for each class of prescription drugs using design-based Rao–Scott χ^2 tests [28]. Similar analyses were conducted considering age at onset for use of any of the four classes of prescription drugs, and development of any prescription drug abuse or dependence.

Multivariate logistic regression models were also fitted to the two outcomes indicating any life-time prescription drug abuse and dependence, in addition to the eight outcomes indicating diagnoses of abuse or dependence for the four different classes of prescription drugs. Predictors of these outcomes included age at onset of any NMUPD (or specific age at onset for a given class of prescription drugs) and a series of covariates [age, sex, ethnicity, current marital status, family alcohol history, polydrug use, age at onset of alcohol use and drug use status (current user versus ex-user)] based on findings in previous literature [4,20]. Only the subpopulation of individuals indicating some form of life-time NMUPD and reporting an age at onset of NMUPD were considered in the logistic regression analyses. In particular, the age at onset of NMUPD was missing for five sedative users, three tranquilizer users, three opioid users and one stimulant user. Estimates of 95% confidence intervals for the adjusted odds ratios (AOR) in the models were computed based on the complex design of the NESARC sample.

RESULTS

Prevalence and age at onset of non-medical use of prescription drugs

Based on the NESARC sample data, an estimated 9.1% (95% CI = 8.5%, 9.8%) of US adults were life-time non-medical users of at least one of four prescription drug classes (i.e. sedatives, tranquilizers, opioids or stimulants) in 2001–2002. Among all life-time non-medical users of prescription drugs, approximately 53.5% used one prescription drug class, 21.3% used two prescription drug classes, 12.0% used three prescription drug classes, and 13.3% used four prescription drug classes. The estimated prevalence of life-time non-medical use for individual prescription drug classes among US adults was 4.1% (95% CI = 3.8%, 4.4%) for sedatives, 3.4% (95% CI = 3.2%, 3.7%) for tranquilizers, 4.7% (95% CI = 4.4%, 5.1%) for opioids and 4.7% (95% CI = 4.2%, 5.1%) for stimulants.

The estimated mean ages at onset for life-time NMUPD were as follows: sedatives (23.14 years, SE = 0.36), tranquilizers (22.68 years, SE = 0.35), opioids (23.19 years, SE = 0.31) and stimulants (18.96 years, SE = 0.13). The median ages at onset and age ranges for life-time NMUPD were as follows: sedatives (20.00 years, range = 5–89 years), tranquilizers (20.00 years, range = 5–89 years), opioids (20.00, range = 5–88 years) and stimulants (18.00 years, range = 5–52 years). The estimated percentages of those who initiated non-medical use of each specific class of prescription drugs before the age of 21 (based on the subsamples of respondents indicating life-time non-medical use of a given drug class) were as follows: sedatives (57.0%, $n = 1566$), tranquilizers (55.3%, $n = 1269$), opioids (54.5%, $n = 1752$), stimulants (74.6%, $n = 1736$) and any NMUPD (61.5%, $n = 3463$; sample sizes include those with valid ages of onset).

Among life-time users of each class of prescription drugs, the average age at onset for each class was also estimated for the different age cohorts (18–24 years, 25–44 years, 45–64 years and 65 years and older), and the average age at onset increased significantly as a function of age cohort for each of the prescription drug classes ($P < 0.01$), suggesting that younger respondents were more likely to start using prescription drugs non-medically at earlier ages. Finally, the pattern of polydrug use among non-medical users of prescription drugs was examined, and the results indicated that a considerable number of individuals who initiate non-medical use of prescription drugs at an early age are also using alcohol and other drugs. For example, across the four prescription drug classes considered in this study, approximately 75% to 97% of individuals who initiated NMUPD for the first time at age 15 were also using alcohol and/or other drugs.

Prevalence of prescription drug abuse as a function of age at onset

Among life-time non-medical users of prescription drugs, an estimated 27.4% (95% CI = 25.6%, 29.3%) went on to develop prescription drug abuse during their life-time. The estimated percentages of sedative, tranquilizer, opioid and stimulant non-medical users who progressed to abuse during their life-times were 20.7% (95% CI = 18.3%, 23.4%), 22.6% (95% CI = 19.9%, 25.6%), 23.8% (95% CI = 21.4%, 26.4%) and 31.0% (95% CI = 28.4%, 33.7%), respectively.

The prevalence rates of life-time prescription drug abuse were examined for each year at onset from 13 years of age and younger to 21 years of age and older. Among non-medical users, the prevalence of life-time prescription drug abuse was higher among early initiators for each prescription drug class (see Table 1). Age of onset had a significant ($P < 0.05$) association with development of life-time prescription drug abuse in each of the four classes of prescription drugs, with those having an earlier age of onset being consistently more likely to develop abuse.

The trend of higher prevalence rates of life-time prescription drug abuse among early initiators held true for non-medical use of any of the four classes of prescription drugs as well. As illustrated in Fig. 1, the prevalence of any life-time prescription drug abuse increased

significantly as a function of lower age at onset of any NMUPD (Rao–Scott $\chi^2_8 = 77.13$, $P < 0.001$). Specifically, among individuals who report life-time NMUPD, approximately 42.1% (95% CI = 34.3%, 50.4%) of those who started any NMUPD at or before 13 years of age went on to develop prescription drug abuse in their life-time compared to 17.1% (95% CI = 14.9%, 19.7%) of the respondents who initiated NMUPD at or above 21 years of age. In an effort to examine the potential differential effects as a function of age of the respondent, the above-mentioned analyses were repeated separately for different age cohorts (18–24 years, 25–44 years, 45–64 years) and the same patterns of results were found for each of the age groups.

Prevalence of prescription drug dependence as a function of age at onset

Among life-time non-medical users of prescription drugs, approximately 10.3% (95% CI = 9.1%, 11.7%) went on to develop prescription drug dependence during their lifetime. The estimated percentages of sedative, tranquilizer, opioid and stimulant non-medical users who progressed to dependence on each of these substances during their life-times were 6.1% (95% CI = 4.9%, 7.6%), 6.6% (95% CI = 5.1%, 8.4%), 7.2% (95% CI = 5.8%, 9.0%) and 13.0% (95% CI = 11.0%, 15.2%), respectively.

The bivariate associations between life-time prescription drug dependence and age at onset of NMUPD were also examined for each prescription drug class. As illustrated in Table 2, life-time prescription drug dependence was more prevalent among early initiators for each prescription drug class. Age of onset was found to have a significant ($P < 0.05$) or marginally significant ($P < 0.10$) inverse association with development of lifetime prescription drug dependence in two of the four classes of prescription drugs (opioids and stimulants), and the estimated prevalence of dependence was generally lower for higher ages of onset across the four prescription drug classes.

As illustrated in Fig. 2, the prevalence of any life-time prescription drug dependence increased significantly as a function of lower age at onset of NMUPD (Rao–Scott $\chi^2_8 = 36.01$, $P < 0.001$). Among individuals who report life-time NMUPD, approximately 25.3% (95% CI = 17.9%, 34.4%) of those who started any NMUPD at or before 13 years of age went on to develop prescription drug dependence in their life-time compared to 7.0% (95% CI = 5.5%, 8.9%) of the respondents who initiated NMUPD at or above 21 years of age. In an effort to examine the potential differential effects as a function of age of the respondent, the above-mentioned analyses were repeated separately for different age cohorts (18–24 years, 25–44 years, 45–64 years), and similar patterns of results were found for each of the age groups.

Possible ‘cross-class’ findings, regarding the likelihood of non-medical users of a particular prescription drug either (i) developing a drug use disorder (abuse or dependence) involving that particular drug or (ii) eventually becoming a non-medical user of another prescription drug, were also examined based on ages of onset. The results indicated that early non-medical users of prescription sedatives, tranquilizers and opioids were generally more likely to become non-medical users of other prescription drug classes than develop sedative, tranquilizer or opioid use disorders. For example, among individuals who initiated non-medical use of prescription sedatives at 13 years of age or younger, approximately 43% developed a sedative use disorder as compared to 75% who eventually used prescription tranquilizers, 72% who eventually used prescription opioids and 70% who eventually used prescription stimulants. Interestingly, non-medical users of prescription stimulants from all ages of onset were generally more likely to develop stimulant use disorders than to eventually become non-medical users of other prescription drugs.

Multivariate results

Multivariate logistic regression analyses indicated that early onset of NMUPD was associated with a significantly higher probability of receiving any life-time diagnoses of prescription drug abuse and dependence. Specifically, when controlling statistically for the other covariates in the models, the odds of developing any life-time prescription drug abuse among non-medical users were reduced by about 5% with each year non-medical use was delayed (AOR = 0.95, 95% CI = 0.94, 0.97), and the odds of developing any life-time prescription drug dependence were reduced by approximately 2% with each year onset was delayed (AOR = 0.98, 95% CI = 0.96, 1.00). As illustrated in Table 3, positive family history of alcoholism and polydrug use were both associated with significantly increased odds of developing prescription drug abuse and dependence. Furthermore, males were more likely than females to develop prescription drug abuse, but the inverse relationship was found with respect to prescription drug dependence. Finally, early onset of alcohol use was associated with increased odds of prescription drug dependence.

Multivariate logistic regression models were also fitted to the eight binary outcomes indicating diagnoses of abuse or dependence for each of the four classes of prescription drugs. These models included the same socio-demographic and drug use covariates, in addition to class-specific age of onset (analyses were focused on the subgroups of respondents indicating life-time use of each class with non-missing ages of onset). Results showed that with the exception of the dependence diagnoses for sedatives and stimulants, age of onset for each class of prescription drugs had a significant ($P < 0.05$, for five of the remaining six diagnoses) or marginally significant ($P < 0.10$, for opioid dependence) negative relationship with the probability of developing either abuse or dependence.

Multivariate logistic regression models were also fitted to life-time diagnoses of abuse or dependence for different age cohorts (18–24 years, 25–44 years, 45–64 years and 65 years and older). These models included the same covariates with the exception of the age cohort variable. The results indicated that age of onset for each age cohort had a significant ($P < 0.05$) negative relationship with the probability of developing either abuse or dependence.

DISCUSSION

The findings from the present study provide new evidence that early onset of NMUPD is a significant predictor for the development of prescription drug abuse and dependence based on a nationally representative sample of adults in the United States. One-year increases in age at onset of NMUPD reduced the odds of developing any lifetime diagnosis of prescription drug abuse by 5% and reduced the odds of receiving any life-time diagnosis of prescription drug dependence by 2%.

The findings from the present study extend our knowledge of age at onset of NMUPD in several important ways. First, although it is known that early initiation of alcohol and illicit drugs is associated with increased risk of developing substance use disorders, the association between early age at onset of NMUPD and DUDs involving prescription drugs has remained relatively unexplored. The patterns observed in the present study reinforce previous findings but extend these relationships specifically to prescription drugs. The present study found a significant association between age at onset of NMUPD and the likelihood of developing prescription drug abuse for each of the four classes of scheduled prescription drugs (i.e. sedatives, tranquilizers, opioids, stimulants). The results also indicated that non-medical use of prescription stimulants may deserve special attention because this drug use behavior was associated with particularly high rates of stimulant use disorders relative to the other prescription drug classes. Secondly, previous studies have combined DSM-IV categories of prescription drug abuse and dependence [20,29], but the present study found different patterns

and risk factors for these two DSM-IV diagnoses, suggesting that they should be examined separately. Thirdly, previous research has examined the association between NMUPD and past-year prescription drug abuse and dependence beginning with 16 years of age [29]. The present study revealed effects of initiation of NMUPD earlier than 16 years of age.

Previous research has shown that NMUPD is most prevalent among adolescents and young adults in the United States [6,20,30,31]. The present study found that nearly one in every 10 adults aged 18 years or older in the United States reported life-time NMUPD, and the majority of life-time non-medical users of prescription drugs initiated such use before 21 years of age. Based on the increased risk associated with early onset, these findings reinforce the importance of developing prevention efforts aimed at reducing NMUPD among children and adolescents.

The present study also indicated strong associations between the early onset of alcohol use and family history of alcoholism with the development of prescription drug use disorders, which is consistent with previous evidence showing that these factors serve as robust risk factors for alcohol and other drug use disorders [3,4]. Dawson [32] suggested that the association between family history of alcoholism and alcohol dependence is explained in part by earlier initiation of drinking. Longitudinal studies are needed to assess the hypothesis that the effect of family history of alcoholism on prescription drug use disorders is mediated by age at first use.

Among non-medical users of prescription drugs, males were more likely to develop prescription drug abuse, while females were more likely to develop prescription drug dependence. These results reinforce the importance of examining DSM-IV diagnoses of abuse and dependence separately when considering gender differences in prescription drug use disorders rather than combining these categories. Our results are similar to earlier findings, which showed that females were more likely than males to report criteria consistent with dependence and heavy use of prescription drugs [33]; however, in general the gender differences among non-medical users of prescription drugs vary by age group and prescription drug class [6,29,33,34]. Finally, polydrug use was found to be associated with increased odds of prescription drug abuse and dependence. Based on the high rates of poly-drug use among non-medical users of prescription drugs, the role of early initiation of alcohol and other drug use and polydrug use involving prescription drugs should be considered carefully in assessing and understanding the subsequent development of prescription drug use disorders.

Strengths and limitations

The present study had several strengths. First, the NESARC is one of the few national studies that assessed life-time DSM-IV drug abuse and dependence for specific prescription drug classes. Secondly, the inclusion of DSM-IV criteria to assess life-time prescription drug abuse and dependence in a large national sample is a unique strength for the NESARC, and the large sample size of the NESARC allowed for the calculation of prevalence estimates of individual prescription drug classes. Finally, the nationally representative nature of the sample allowed us to generalize our findings to the civilian non-institutionalized population, 18 years of age and older, residing in the United States.

This study also had limitations that should be taken into account. First, as the present study represented secondary analyses, the survey items in the NESARC limited what could be examined. For example, the prevalence estimates of life-time prescription drug abuse and dependence were probably underestimated because the NESARC did not list some commonly misused prescription drugs (e.g. Vicodin, OxyContin, Ritalin, Adderall), which have high rates of NMUPD [6,31,35]. These omissions are not unique to the NESARC and at least some of these drugs are missing from other national studies such as Monitoring the Future (MTF) [6]. However, as noted previously [30], the list of prescription drugs listed in the NESARC is less comprehensive than other studies such as the National Survey on Drug Use and Health

(NSDUH); this could partially explain the lower prevalence rates of NMUPD based on the NESARC data. In addition, the differences between the present study and other national studies may be due partially to differences in the wording for classes of prescription drugs (e.g. 'narcotics other than heroin' in the MTF, 'pain relievers' in the NSDUH and 'painkillers' in the NESARC) and/or wording for NMUPD measures (e.g. '... to get high' from the NESARC versus '... for the experience or feeling it caused' from the NSDUH). Furthermore, the measures to assess non-medical use of all three national studies fail to distinguish between patients who misuse their own medication or, alternatively, individuals who use someone else's prescription drugs non-medically. Therefore, consideration should be given to the impact of using different terminology to assess non-medical use of prescription drugs based on the complexity of this behavior [36]. Secondly, the present study probably underestimated the prevalence of NMUPD in the United States because high-risk groups of individuals were not included in the NESARC (e.g. the incarcerated, homeless and transient individuals). Thirdly, although we found evidence that older respondents were more likely to start using prescription drugs non-medically at later ages, the present study relied on retrospective reports of age at first drug use which could be subject to memory-related biases such as recall decay and telescoping, especially among older respondents. Finally, the results of the present study may not generalize to populations outside the United States, and international research is needed to examine societal and cultural differences in NMUPD as well as drug use disorders involving prescription drugs.

Future practice and research

The findings of the present study reinforce the importance of preventative efforts to delay the age at initiation of NMUPD (or prevent onset entirely). Although there are several drug education and prevention programs designed for middle school and high school students [37], in general these programs have not been successful in reducing prescription drug abuse [38]. While prevention efforts to reduce NMUPD should be part of existing substance abuse prevention programs based on the high rates of polydrug use among non-medical users of prescription drugs, available evidence indicates that adolescents and young adults engage in NMUPD for different reasons than other forms of substance use [35,39,40]. For example, the most prevalent reason adolescents and young adults used prescription opioids non-medically was to relieve pain [39,40]. In many respects, NMUPD and diversion of prescription drugs are behaviors that challenge traditional ways of educating about drug abuse because prescription drugs are also critical for the treatment of attention deficit hyperactivity disorder and sleep and anxiety disorders, as well as management of pain in adolescents. Based on the limitations of measures used to assess non-medical use in current studies, future research should examine whether there are particular subtypes of non-medical use that are more likely to lead to subsequent abuse and dependence. Future research should also consider qualitative approaches to examine non-medical use of prescription drugs.

Despite the limitations, the findings of the present study can be used for generating hypotheses and future research should examine the factors that contribute to early onset of NMUPD. Because prescription drugs are used to treat effectively legitimate disorders and conditions, traditional models that explain the onset and course of use for illicit drugs may not apply completely to NMUPD. Thus, this form of drug use has posed considerable challenges for the substance abuse field. Longitudinal studies are needed to examine the natural history of NMUPD among youth in the United States.

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Figure 1. Estimated prevalence of any life-time prescription drug abuse by age at first non-medical use of any prescription drugs, 2001–2002. Error bars indicate ± 1 standard error.

Figure 2. Prevalence of any life-time prescription drug dependence by age at first non-medical use of any prescription drugs, 2001–2002. Error bars indicate ± 1 standard error.

Table 1

Prevalence estimates of life-time drug abuse for four prescription drug classes, by age at first non-medical use for each class, 2001–2002.

Age at first non-medical use	Life-time sedative abuse (n = 1566 [*]) % (SE); n	Life-time tranquilizer abuse (n = 1269 [*]) % (SE); n	Life-time opioid abuse (n = 1752 [*]) % (SE); n	Life-time stimulant abuse (n = 1736 [*]) % (SE); n
13 years or younger	30.27% (5.55); n = 75	33.25% (7.40); n = 46	35.06% (7.41); n = 67	38.01% (5.98); n = 80
14 years	29.29% (9.46); n = 36	27.85% (8.89); n = 37	23.69% (7.12); n = 46	38.78% (6.95); n = 86
15 years	30.87% (6.14); n = 73	40.74% (7.63); n = 55	34.95% (6.83); n = 74	32.48% (5.05); n = 107
16 years	35.58% (4.78); n = 156	41.56% (6.20); n = 96	34.65% (4.55); n = 134	35.60% (3.58); n = 244
17 years	23.32% (4.45); n = 129	27.32% (5.93); n = 91	32.62% (5.14); n = 138	33.58% (3.95); n = 199
18 years	26.01% (3.94); n = 190	29.97% (4.06); n = 146	25.38% (3.59); n = 215	36.85% (3.48); n = 248
19 years	25.85% (5.97); n = 87	27.09% (5.41); n = 83	22.27% (5.23); n = 105	20.49% (3.74); n = 141
20 years	23.54% (5.27); n = 113	19.59% (4.39); n = 105	23.81% (4.41); n = 127	27.59% (4.49); n = 144
21 years or older	11.58% (1.29); n = 707	13.20% (2.00); n = 610	18.62% (1.73); n = 846	24.82% (2.33); n = 487
Rao–Scott χ^2_8 P-value	45.74, $P < 0.001$	32.31, $P < 0.001$	29.57, $P = 0.001$	17.35, $P = 0.04$

* Sample sizes represent life-time non-medical users of each prescription drug class with valid (i.e. non-missing) ages of onset. Unweighted Ns. SE: standard error.

Table 2

Prevalence estimates of life-time drug dependence for four prescription drug classes, by age at first non-medical use for each class, 2001–2002.

Age at first non-medical use	Life-time sedative dependence(n = 1566 [*]) % (SE); n	Life-time tranquilizer dependence(n = 1269 [*]) % (SE); n	Life-time opioid dependence(n = 1752 [*]) % (SE); n	Life-time stimulant dependence(n = 1736 [*]) % (SE); n
13 years or younger	15.88% (5.89); n = 75	21.00% (7.78); n = 46	25.02% (7.10); n = 67	30.64% (6.28); n = 80
14 years	31.16% (10.74); n = 36	22.94% (7.66); n = 37	20.44% (7.55); n = 46	17.13% (4.43); n = 86
15 years	5.50% (2.20); n = 73	10.28% (4.29); n = 55	1.75% (1.51); n = 74	17.38% (4.59); n = 107
16 years	4.45% (1.81); n = 156	5.64% (2.82); n = 96	6.39% (2.31); n = 134	13.76% (2.62); n = 244
17 years	7.50% (2.56); n = 129	6.35% (2.49); n = 91	8.39% (2.66); n = 138	14.02% (3.53); n = 199
18 years	6.72% (1.91); n = 190	6.25% (2.15); n = 146	8.88% (2.31); n = 215	10.41% (2.31); n = 248
19 years	7.06% (3.20); n = 87	8.52% (3.11); n = 83	8.19% (2.77); n = 105	12.62% (4.01); n = 141
20 years	1.81% (1.35); n = 113	3.03% (1.69); n = 105	1.28% (0.75); n = 127	6.59% (1.93); n = 144
21 years or older	4.96% (0.91); n = 707	4.98% (1.19); n = 610	6.49% (1.19); n = 846	10.68% (1.66); n = 487
Rao–Scott χ^2_8 , P-value	12.75, $P = 0.14$	9.98, $P = 0.29$	29.62, $P < 0.01$	15.45, $P = 0.07$

* Sample sizes represent life-time non-medical users of each prescription drug class with valid (i.e. non-missing) ages of onset. Unweighted Ns. SE: standard error.

Table 3
Multivariate logistic regression results for prescription drug abuse and dependence, 2001–2002.

	Life-time prescription drug abuse AOR (95% CI)	Life-time prescription drug dependence AOR (95% CI)
Age at first non-medical use (in years)	0.95 (0.94, 0.97) ***	0.98 (0.96, 1.00) *
Age		
65 years and older	—	—
45–64 years	1.22 (0.65, 2.30)	0.80 (0.33, 1.96)
25–44 years	1.09 (0.58, 2.06)	0.62 (0.25, 1.58)
18–24 years	0.68 (0.34, 1.35)	0.94 (0.33, 2.66)
Sex		
Female	—	—
Male	1.44 (1.18, 1.76) ***	0.63 (0.46, 0.87) **
Race/ethnicity		
White	—	—
Black	0.85 (0.58, 1.25)	0.91 (0.54, 1.54)
Native American	1.05 (0.58, 1.90)	1.51 (0.76, 3.00)
Asian	0.92 (0.44, 1.92)	0.83 (0.33, 2.08)
Hispanic	1.06 (0.76, 1.48)	1.45 (0.93, 2.27)
Current marital status		
Married/cohabitating	—	—
Widowed/divorced/separated	1.12 (0.86, 1.46)	1.25 (0.86, 1.80)
Never married	1.01 (0.78, 1.31)	0.91 (0.57, 1.44)
Family history of alcoholism		
Negative history	—	—
Positive history	1.66 (1.33, 2.07) ***	1.77 (1.25, 2.51) **
Drug use status		
Ex-user (before past year)	—	—
Current user (past year)	1.04 (0.83, 1.31)	1.09 (0.81, 1.49)
Life-time polydrug use		
One prescription drug	—	—
Two prescription drugs	1.27 (0.97, 1.67)	1.96 (1.31, 2.93) **
Three prescription drugs	2.03 (1.54, 2.68) ***	2.62 (1.67, 4.11) ***
Four prescription drugs	2.90 (2.12, 3.97) ***	3.68 (2.46, 5.49) ***
Age at onset of alcohol use		
Life-time abstainer/21 years or older	—	—
18–20 years	0.75 (0.54, 1.03)	1.22 (0.67, 2.20)
14–17 years	1.06 (0.76, 1.46)	1.03 (0.57, 1.87)
Less than 13 years	0.91 (0.60, 1.37)	2.36 (1.24, 4.47) **

—, Reference group.

* $P < 0.05$,

** $P < 0.01$,

*** $P < 0.001$. AOR: adjusted odds ratio.