Full length article

Age-related patterns in nonmedical prescription opioid use and disorder in the US population at ages 12-34 from 2002 to 2014[*]

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ABSTRACT

Objectives: To estimate age-related patterns in nonmedical prescription opioid (NMPO) use in the US population and disorder among past-year users at ages 12–34 between 2002 and 2014, controlling for period and birth-cohort effects.

Methods: Data are from 13 consecutive cross-sectional *National Surveys on Drug Use and Health* (N = 542,556). Synthetic longitudinal cohorts spanning ages 12–34 were created and an age-period-cohort analysis was implemented based on the Intrinsic Estimator algorithm.

Results: In every birth cohort, past-year NMPO use increases during adolescence, peaks at ages 18–21, decreases through ages 30–34; disorder among past-year users increases from ages 18–21 through 30–34. Use at ages 12–34 decreased from the 1984-87 birth cohorts to more recently-born cohorts. Peak prevalence of use at ages 18–21 has also decreased, and the rates of increase from ages 14–17 to ages 18–21 are slowing down. Disorder at ages 18–34 increased from the 1976-79 to 1992-95 cohorts, but decreased at ages 12–17 from the 1992-95 to the most recently-born 2000–02 cohorts. The years 2010–2014 were characterized by lower NMPO use but higher disorder than 2002–2009.

Conclusions: Increasing NMPO disorder among users aged 18–34 warrants concern. However, declining NMPO use among 12–34 year-olds, a declining rate of increase from adolescence to early adulthood, and a suggestive decline in disorder among the most recent adolescent cohorts may forecast a potential reduction in the public health crisis associated with NMPO drugs.

1. Introduction

The use and associated morbidity of nonmedical prescription opioid (NMPO) constitute major public health problems that have become the focus of intense governmental, media and scientific attention (Compton et al., 2015; Volkow et al., 2014). In 2015, the government announced an initiative, updated in 2016 (The White House, 2016), to address prescription drug abuse and heroin use. The initiative emphasized prescriber training, increasing naloxone use, and improving access to treatment. Many states implemented legislation to control medical prescription of opioids (Franklin et al., 2015; Johnson, 2014). Several reports have described patterns of use (Kerridge et al., 2015; Martins et al., 2014), risk factors for use (Katz et al., 2013), or trends in NMPO use and disorder prevalence among adolescents and adults (Han et al., 2015; Jones, 2017; Martins et al., 2017; McCabe et al., 2014). From 2003–2014, overall prevalence of NMPO use decreased, while

prevalence of frequent use and disorder increased (Han et al., 2015; Jones, 2017). Trends differed by age and use pattern. In the population, use decreased among adolescents aged 12–17 and young adults aged 18–25; disorders decreased among adolescents, but increased among those older than 25 (Jones, 2017). Among users, disorders increased among those aged 18–34 (Martins et al., 2017). While several studies have investigated NMPO use in specific age groups, especially adolescents, college students (Boyd et al., 2009; McCabe et al., 2013; McCabe et al., 2014; Nargiso et al., 2015) or older adults (Schepis and McCabe, 2016), rarely have use patterns been examined by age over time in the same sample (Han et al., 2015; Jones, 2017; Martins et al., 2017; Miech et al., 2013).

The use of drugs, whether legal or illegal, is an age-graded behavior, with prevalence generally the highest in early adulthood (CBHSQ, 2015a; Kandel et al., 2017). Use increases sharply from adolescence to ages 18–25 for cigarettes, alcohol, marijuana, cocaine, and heroin, and

starts to decline as of age 26 for marijuana and cocaine, and age 35 for other drugs. As discussed later, age patterns for NMPOs are similar to those for marijuana and cocaine. Changes in drug use over the life cycle reflect different biological, psychological and social influences in the context of normative transitions in social roles (Schulenberg and Maggs, 2001). Onset and escalation of use in adolescence is thought to develop in response to peer pressure, risk-taking and sensation-seeking in a period of major changes in brain development. The decline beginning in the mid-twenties reflects the assumption of traditional adult work and family roles (Griffin, 2010; Sussman, 2013), and their incompatibility with substance use (Yamaguchi, 1990; Yamaguchi and Kandel, 1985). Similar processes likely apply to NMPO use.

However, age comparisons at one time point or across successive cross-sectional surveys may not reflect true maturational changes, since cross-sectional age differences confound developmental changes with cohort differences and period effects. Variations over time in behaviors by age results from three types of changes: "*Age effects,* or variation associated with different age groups; *period effects,* or variation over time periods that affect all age groups simultaneously; and *cohort effects* or changes across groups of individuals who experience an initial event, such as birth in the same year (pp. 1697-98)" (Yang et al., 2008). Period and cohort effects reflect social and environmental influences. Miech et al. (2013) implemented an age-cohort-period analysis of NMPO use in the population between 1985 and 2009, the youngest cohorts born in 1990-94, the oldest in 1930-34. The prevalence of nonmedical analgesics (opioids), increased across all cohorts and ages in recent years (2006–2009), especially among youths aged 15–24.

We here examine age-related patterns of NMPO use and disorder from adolescence to adulthood from 2002 to 2014, the most recent year for which national data from the *National Survey on Drug Use and Health* (NSDUH) (SAMHSA, 2015a) can be used for trend analysis. Changes in question wording preclude comparisons of 2015 data with data from earlier surveys (CBHSQ, 2015b). To identify age differences in use and disorder over time, which reflect true developmental changes independent of period and cohort effects, we implemented an age-period-cohort analysis (Yang et al., 2008) for ages 12–34. This age range includes the periods of onset into NMPO use and of highest prevalence of use in the population. Synthetic longitudinal cohorts were created by following members of different birth cohorts as they age in successive cross-sectional national surveys. NMPO use disorder was examined among users, rather than in the population, to control for historical changes in prevalence of use. The synthetic cohorts approximate a longitudinal design and permit an assessment of developmental changes in NMPO use and disorder, while controlling for potentially confounding period and cohort effects. By disaggregating patterns of NMPO use and disorder by birth cohorts, we provide historical insights into these patterns that enhance our understanding of current NMPO behavior and may help anticipate future trends.

2. Methods

2.1. Sample

Data are from 13 consecutive cross-sectional surveys (2002–2014) from the NSDUH, annual cross-sectional surveys of drug use in multi-stage representative probability samples of the US population aged 12 and older (SAMHSA, 2015a). The target civilian non-institutionalized population represents over 98% of the population. Persons in non-in-stitutional group quarters (homeless shelters, rooming houses, college dormitories), civilians on military bases are included; individuals on active military duty, in jail, drug treatment programs, hospitals, the homeless not in shelters are excluded. Age groups at highest risk for drug use (12–17, 18–25) are oversampled (CBHSQ, 2015c). Approximately 67,500 persons are interviewed annually. Completion rates range from 63% to 70%. Public use data sets were used for ages 12–34. The birth cohorts included in the analysis ranged from 1972 to 2002.

The study was granted expedited approval by the New York State Psychiatric Institute − Columbia University Department of Psychiatry Institutional Review Board.

2.2. Data collection and measures

Data were collected with computer-assisted personal interviews (CAPI) by an interviewer, and audio-computer assisted self-inter-viewing (ACASI) for substance use.

2.3. Self-reported use of nonmedical prescription opioids

Asked about use of prescription pain relievers (opioids) without a prescription or for the experience or feeling they caused; 21 specific pain relievers were listed. Respondents were asked about lifetime use and how long ago they last used the drugs. Past-year use (12 months) = 1; no = 0.

NMPO use disorder: Met DSM-IV criteria for abuse (1 of 4 criteria) or dependence (3 of 7 criteria). Ascertained among past 12-month NMPO users.

Age: In the data set, coded in single years for ages 12–21; grouped for ages 22–23, 24–25, 26–29, and 30–34.

2.4. Statistical analysis

2.4.1. Creation of synthetic cohorts for ages 12–34

Synthetic longitudinal cohorts were created with cross-sectional data from the 13 surveys from 2002 to 2014 for ages 12–34 (N = 542,556). Each survey includes representative members of birth cohorts, who can be followed in successive surveys as they age. Because of aggregated age coding, single year birth cohorts could not be tracked over time after age 21. Cohorts were grouped so that number of ages and years in each period were equal. Due to constraints imposed by the age grouping, four years was the optimal equal-time duration. Four periods were defined: 2002–2005; 2006–2009; 2010–2013; 2014, a single year. Birth cohorts were aggregated over successive four-year intervals, except for 2014. Nine birth cohorts groups (born from 1972 to 2002) were constructed spanning ages 12–13, 14–17, 18–21, 22–25, 26–29, 30–34 (Supplementary Table 1). Because ages 10–11 are not surveyed in the NSDUH, ages 12–13 are limited to two-years; because of age coding by NSDUH, 30–34 includes 5 years. Two cohorts were assessed only once: cohort 1972-75 at ages 30–34; cohort 2002 at ages 12–13. Two cohorts were assessed twice: cohort 1976-79 at ages 26–29 and 30–34; cohort 2000–01 at ages 12–13 and 14–17. Two cohorts were assessed three times: cohort 1980-83 at ages 22–25, 26–29, 30–34; cohort 1996-99 at ages 12–13, 14–17, and 18–21. Three cohorts were assessed four times: cohort 1984-87 from ages 18–21 to 30–34; cohort 1988-91, from ages 14–17 to 26–29; and cohort 1992-95, from ages 12–13 to 22–25. Hence, birth cohorts were tracked over different lengths of time, ranging from 1 to 12 years, and covered ages 12–13 to 22–25, ages 14–17 to 26–29, and ages 18–21 to 30–34.

2.4.2. Estimation of age, period and cohort effects for past-year NMPO use in the population and disorder among users at ages 12–34

Two age-period-cohort analyses (APC) were performed using the intrinsic estimator (IE) (Yang et al., 2008) to examine (1) the mutually adjusted effects of age, period and cohort on NMPO use in the population, and (2) disorder among users, from 2002 to 2014. Disorders were examined among NMPO users to control for historical changes in prevalence of NMPO use in the population. The aggregation of time (for ages, cohorts, and periods) was 4 years. Although assessed only once, two groups (2002 and 1972-75 cohorts) were included in the APC analysis. Past-year NMPO use and disorder were expressed as a logistic function:

$$\text{Log}(P/(1-P)) = u + \alpha_i + \beta_j + \Upsilon_k,$$