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Increasing Use of Nonmedical Analgesics Among Younger Cohorts in the United States: A Birth Cohort Effect

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Abstract

Purpose—Nonmedical use of prescription pain drugs (hereafter ‘analgesics’) has increased substantially in recent years. It is not known whether today’s youth are disproportionately driving this increase or, instead, the trend is a general one that has affected cohorts of all ages similarly. To address this question we present the first age-period-cohort analysis of nonmedical use of analgesics.

Methods—Data come from the National Survey on Drug Use and Health, a series of annual, nationally-representative, cross-sectional surveys of the U.S. civilian, non-institutionalized population. The analysis focuses on the years 1985 to 2009 and uses the recently developed ‘intrinsic estimator’ algorithm to disentangle age-period-cohort effects.

Results—Substantial increases in the prevalence of nonmedical analgesics use have occurred across all cohorts and ages in recent years, but this increase is significantly amplified among today’s adolescents. The odds of past-year, nonmedical analgesics use for today’s youngest cohort (born 1980–1994) are higher than would be expected on the basis of their age and broad, historical period influences that have increased use across people of all ages and cohorts. The independent influence of cohort on past-year, nonmedical analgesics use is about 40% higher for today’s youth cohort than any of the cohorts that came before them. This finding is present among men, women, non-Hispanic whites, non-Hispanic blacks, and Hispanics.

Conclusions—Although nonmedical use of analgesics is evident among all ages, cohorts, and periods, today’s younger cohorts warrant special attention for substance abuse policies and interventions targeted at reversing the increase in nonmedical analgesics use.

Keywords

analgesics; prescription drugs; age; period; cohort; trends

INTRODUCTION

Nonmedical use of prescription pain drugs among adolescents has increased substantially in recent decades, contributing to the current ranking of nonmedical prescription drug use as the second most prevalent form of U.S. illegal drug use, behind marijuana [1]. Among adolescents age 12–17 the prevalence of lifetime misuse of prescription analgesics increased more than tenfold from the 1960s to the present, from 0.83% to around 8% today [2, 3]. With this increase has come a concomitant increase in emergency room visits related to opioids (an increase of 129% between 2004 – 2009) [4], an increase in the number of Americans seeking treatment for prescription opioid use (by over 500% from 1997 to 2007) [5], as well as increases in unintentional overdose mortality (at least threefold from the 1990s to 2007) [6], an increase that is mostly due to prescription opioid overdoses [7, 8].

Much remains unknown about the role of today's cohorts of adolescents in the general trend toward increasing nonmedical use of analgesics, the research question of this study. The concept of "cohort" is based on demographic theory [9], and is sometimes referred to as a "generation," such as the Baby Boom generation or the "X" generation. Birth cohorts have distinct composition and character that reflect their unique historical circumstances [9]. They develop distinctive beliefs and behaviors on issues as diverse as obesity [10], political beliefs [11], and, most important for this study, illegal drug use [12]. This study investigates whether today's younger cohorts have developed either a higher or lower prevalence of nonmedical analgesics use (hereafter NAU) in comparison to earlier cohorts when they were the same age.

On the one hand, it is possible that today's youth cohorts have developed a distinctly high prevalence of NAU, much as the Baby Boom cohort had distinctly high levels of marijuana use in adolescence [13] that persisted as it aged [14, 15]. Such a finding would be indicated if the prevalence of NAU for today's adolescents are higher than they are for cohorts of adolescents that came before them, and are also above and beyond any overall increase that has affected adolescents and adults alike.

On the other hand, it is also possible that today's youth cohorts are turning away from NAU. For example, the prevalence of past-year marijuana use among today's younger birth cohorts is substantially lower than it was among the Baby Boom cohort when it was the same age [14]. It is possible that the most recent youth cohorts have turned the corner and now have a lower prevalence of NAU in comparison to the youth cohorts that came before them.

Reports to date indicate that among recent cohorts the historical increase in NAU has been larger among younger adults. Analyses based on the Monitoring the Future Survey indicate that all age groups 18–35 had similar NAU prevalence near 2–4% in 1994 (when NAU hit a nadir), and by 2009 it grew to between 8–11% for those younger than 30 and to a smaller 6% for those age 35 [16]. Similarly, reports from the National Survey on Drug Use and

Health indicate that in 2009 past-year NAU had grown to 11.9% among those age 18–25 and to a smaller 4.6% among those age 40–44 [17], a growth from a prevalence of near zero (1.1%) in 1994 [18]. The 2009, past-year NMA prevalence was relatively higher for males, whites, and those with lower income [19], although prevalence has increased for all these demographic groups in recent decades [17].

Specialized methodology can help identify the unique influence of birth cohort on the historical trend in NAU. A portion of the increasing prevalence of NAU is no doubt a ‘historical period’ influence, meaning that the prevalence of NAU increased across the board for people of all birth cohorts and ages. It is necessary to take into account this overall increase in order to correctly specify any additional birth cohort effects specific to today’s youth. Also, the prevalence of NAU declines with advancing age [20] and evaluation of potential birth cohort influences requires statistical analysis that, in effect, compares birth cohorts at similar ages. To estimate these effects we make use of recent developments in age-period-cohort methods [21].

METHODS

Data

Data for the analysis come from the National Survey on Drug Use and Health, a series of annual, nationally-representative, cross-sectional surveys of the U.S. civilian, non-institutionalized population. This study uses the surveys from the years 1985, 1988, and every year from 1990 to 2009 inclusive.

These surveys used a multistage probability sample, with minor variation in the sampling frame over the years from 1985 to present. Because the survey is nationally-representative the demographic composition of the sample mirrors that of the general population for all analyses using the survey-provided weights. The analyses focus on respondents aged 15–59 at each survey wave, for a total of 762,330 respondents.

Interviews were conducted in the respondents’ home by trained interviewers. To maximize the validity of responses and to minimize under-reporting, respondents answered questions about possibly sensitive issues, such as illegal drug use, using a self-administered format. Response rates were typically 80% or higher. More detailed information about the survey is available at the SAMHSA website at <http://www.oas.samhsa.gov/nhsda.htm>.

All information is self-reported. The dependent variable is past-year, nonmedical use of analgesics. To assess NAU the survey asked respondents about prescription pain drugs that they took without a prescription or used only for the experience or feeling they caused. Respondents were presented with a long list of analgesics including oxycodone and hydrocodone products (for the complete list see the codebook for the year of survey) [22]. In the year 1999 and afterwards the public release of the data does not include exact year of age of all respondents, which is necessary to assign them to the correct birth cohorts, and for these years analyses for this study were run on the non-public data files. Independent variables include male, female, non-Hispanic white, non-Hispanic black, and Hispanic. The analysis also includes indicators for age, birth cohorts, and historical period.

Analytic Strategy

The analysis uses the recently developed “intrinsic estimator” approach [21] to estimate the independent effects of cohort, historical period, and age. While age and historical period effects are not of central interest in this study, the analysis controls these influences in order to estimate the independent effect of cohorts on NAU.

Past-year NAU of analgesics is expressed as the function:

$$\text{Logit}(Y_{ij}) = \alpha + C_k + P_j + A_i + e_{ij} \quad (1)$$

where the effect of the k -th cohort is given by C_k , the effect of the j -th period by P_j , and the effect of the i -th age group is given by A_i ; where α is a constant and e_{ij} is random disturbance. The age-period-cohort algorithm requires cells of equal time duration and per demographic custom study age, period, and cohort were each subdivided into five-year groups. Age consists of nine five-year groups starting with age 15–19 and ending with age 55–59, and cohort consists of 13 five-year periods starting at 1930.

The “intrinsic estimator” approach is a principal components estimator that provides a unique solution to equation (1) and thereby addresses issues of empirical identification that make it challenging to find a single solution for this model [23]. The method produces unbiased and efficient regression coefficients, and has performed well in simulation studies [21]. We use the publicly available add-on file for the “intrinsic estimator” algorithm [21] available in StataMP version 9.0 [24]. All analyses are weighted to take into account the complex survey design.

Trends in NAU are indicated by comparing the magnitude of five-year group coefficients. For example, a finding that cohort effects are largest among the most recent cohorts would indicate that the influence of cohort, independent of historical period and age, are strongest among today’s youngest cohorts. A statistically significant cohort coefficient indicate that it significantly differs from the overall mean of all cohort effects. Similarly, the reference group for age coefficients is the overall mean of all age effects and the reference group of period coefficients is the overall mean of all period effects.

RESULTS

Table 1 presents the overall prevalence of past-year NAU by sex, race/ethnicity, and age groups. All demographic groups show a similar trend in which NMA prevalence declined from 1985–89 through the 1990s, and then reversed and reached its highest level in the most recent historical period of 2005–09 after more than doubling from its nadir. Across all time periods men have higher NMA prevalence than women, and non-Hispanic whites have higher prevalence than non-Hispanic blacks and Hispanics. The analysis next disaggregated these trends with age-period-cohort methodology.

Age-Period-Cohort Results for Men and Women

Table 2 presents results from the age-period-cohort analysis for past-year NAU among men and women (presented graphically in Figure 1). The analysis indicates that today's youth have a distinctively high prevalence of NAU. It is significantly higher than the prevalence among the cohorts that came before them. This risk is in addition to a general increase in NAU across cohorts (an historical period effect). This risk is also in addition to a greater likelihood of NAU among younger as compared to older respondents (an age effect).

Table 2 indicates that birth cohort effects on NAU, independent of age and historical period effects, are strongest among today's youth cohorts. Among women the influence of cohort membership on NAU was strongest among the two most recent birth cohorts of 1985–89 and 1990–94, which had about 45% higher odds of past-year NAU than the reference group of all cohorts combined. Among men the independent influence of cohort was also strongest among the most recent cohorts. For women the three most recent, five-year birth cohorts (from 1980–1994) all had higher risks for past-year NAU, while none of the previous cohorts differed significantly from the reference of all cohorts combined. The findings are similar for men; the four most recent birth cohorts (from 1975–1994) had an elevated risk while none of the previous cohorts differed significantly from the overall mean of all cohorts combined.

The elevated risk for the recent birth cohorts was in addition to an overall, observed increase in past-year NAU that was present across all birth cohorts (a historical period effect). Comparisons across five-year historical periods are calculated by dividing their odds ratios. Across all cohorts the odds of past-year NAU increased by a factor of 2.19 (1.40/.64) among women from the decade spanning 1995–1999 (for which the historical period coefficient is .64, see Table 2) to 2005–2009 (for which the coefficient is 1.4). Among men the odds increased by a factor of 2.28 (1.57/.69) across all cohorts during the same decade.

The elevated risk for the most recent birth cohorts takes into account the fact that NAU varies substantially by age. For both men and women the respondents age 15–24 had the highest prevalence of NAU and this prevalence declined monotonically with age. Female respondents in the youngest age category of 15–19 had odds for NAU that were roughly twice as high (O.R.=1.99) than all age groups combined. Male respondents in the youngest age category were also at heightened risk for NAU in comparison to other groups, and their odds were 87% higher than the odds of all age groups combined (O.R. = 1.87).

In sum, cohort, historical period, and age effects all combine together to create a high risk for NMA among today's youngest cohorts. They live in an historical era when NMA prevalence across all groups is at its highest level ever recorded. Today's youngest cohorts are still in early adulthood, when the prevalence of NAU is at its highest. In addition, today's youngest cohorts have a prevalence that is even higher than would be expected on the basis of these historical period and age effects combined.

Age-Period-Cohort Effects by Race/Ethnicity

Table 2 also presents results from the age-period-cohort analysis for past-year NAU by race/ethnicity, and Figure 2 is a graph of these results. These results indicate that the study

findings are robust and replicate among sub-samples of non-Hispanic white, non-Hispanic black, and Hispanic respondents. Across all groups, the independent influence of birth cohort on NAU is highest among today's youngest cohorts, as indicated by the finding that only the youngest birth cohorts have coefficients that are both positive and significant. For all race/ethnic groups observed the prevalence of NAU is highest in the most recent historical period (2005–09). Additionally, across all race/ethnic groups NAU is highest among the youngest age groups and generally declines with age.

DISCUSSION

This study set out to examine how the recent increase in NAU has been distributed across birth cohorts. We addressed this question with an age-period-cohort analysis using the recently-developed, 'intrinsic estimator' algorithm. Data come from the National Survey on Drug Use and Health, which is a series of annual, nationally-representative, cross-sectional studies of U.S. drug use. The analysis used data from the 25 year period extending from 1985 to 2009.

The results indicate that membership in today's youth cohorts confers a distinctly high odds of NAU, above and beyond the odds associated with youth ('age' effects) and today's historical period ('period' effects). Taking into account age and period effects, the youngest cohorts had odds of NAU that are about 40% higher than the overall odds of all cohorts combined. This finding was consistent among the subgroups of men, women, non-Hispanic whites, non-Hispanic blacks, and Hispanics.

What is different about today's adolescent cohorts in comparison to past ones that leads to higher NAU? The greater availability of analgesics in recent years likely plays a substantial role. The increasing availability of analgesics in the general population is well documented, as the total number of hydrocodone and oxycodone products prescribed legally in the U.S. increased more than fourfold from about 40 million in 1991 to nearly 180 million in 2007 [1].

Higher prevalence of analgesics makes *first-time* NAU among contemporary youth easier than in the past because more homes have prescription analgesics in their medicine cabinets. The majority of people who use analgesics nonmedically get them from friends and relatives [20]. Today's youth therefore have greater opportunity than youth of the past to act on any desires to try NAU, which is expected to result in higher prevalence.

Another consequence of higher analgesics prevalence is that parents are more likely to model drug use behavior for their children, either intentionally or unintentionally. Youth who observe their parents taking analgesics (as prescribed) may come to the conclusion that any use of these drugs is OK and safe. Work to date on parental modeling and its influence on children's substance use and attitudes has focused on the outcome of smoking [25], and it is plausible similar processes may extend to parental use of analgesics.

Finally, higher prevalence of analgesics facilitates *on-going* NAU among youth. Greater prevalence of analgesics in the general population makes youth more likely to have a family member or friend from whom they can regularly obtain analgesics for nonmedical use

(without or without this provider's knowledge), and, further, greater supply translates into lowers prices for street analgesics among youth who want to purchase them. Such markets are active in an environment where roughly one third of teens believe there is "nothing wrong" with using prescription medications nonmedically "once in a while" [26].

Policies and interventions targeted at reducing the prevalence of adolescent NAU will require innovative strategies that work within this new context of high prescription opioid prevalence. Further work is needed to evaluate the effectiveness of such strategies as increasing parental control of prescription drugs, as well as encouraging parental discussions with adolescents about the dangers of NAU. The results of this study suggest the need for policies and educational programs that are specific to analgesics and not just about drugs in general, given that cohort effects for other substances such as marijuana and binge drinking appear to be declining [14, 27].

This study has limitations. A first limitation is that the 'historical period' effects in our models are affected by two methodological improvements in the NSDUH. The prevalence of drug use increased as a result of the shift from paper-and-pencil to computer-assisted surveys in 1999 and the introduction of respondent incentives in 2002 [28]. These improvements show up in the age-period-cohort estimates as historical period influences because in the specific years that they took place they potentially affected drug use prevalence across all birth cohorts and all ages. As a consequence, the historical period effects in the models reflect both substantive increases in NMA as well as these methodological improvements. These influences do not affect the estimated cohort effects, which are the main focus of this study and for which the historical period effects serve as an important control.

A second, similar limitation is that the list of drugs that comprise the definition of analgesics in the NSDUH has changed over time as new drugs have come on and off the market. These changes also affect the 'historical period' estimates in our models to the extent that the listing of a new analgesic drug in a specific year had the potential to change the overall prevalence of analgesics across all age groups and all birth cohorts. Consequently, the historical period effects are potentially influenced both by changes in the drugs that comprise 'analgesics' as well as methodological improvements in the NSDUH. The 'historical period' estimates absorb these potential bias and in doing so shield the cohort and age estimates.

Third, these results are subject to the limitations inherent to self-report, population-based surveys, as are all national surveys of nonmedical drug use. Adolescents with severe cases of substance misuse may not participate in the survey, and, in addition, among adolescent who do participate it is possible that social desirability bias may lead them to underreport their nonmedical drug use. However, evidence to date indicates that self-reported illegal drug use is valid when respondents believe their confidentiality is protected [29], and the NSDUH emphasizes to respondents the efforts it makes to ensure confidentiality. To the extent that self-reports introduce biases that are constant over time, such biases would not change the substantive conclusions of this study because the analysis focuses on trends over time and not on the absolute level of drug use in any specific year. To the extent that the survey misses

a growing number of adolescents with high levels of NAU, the results of this study are conservative and underestimated.

A final limitation of the study is that it considers only a limited number of demographic factors that may influence past year, NAU. Specifically, the analysis examines the influence of sex and race/ethnicity, both of which are permanent characteristics that support interpretations of one-way causality. Other demographic factors that also play a role in NAU include socioeconomic status, marital status, and region of the country. A careful consideration of these factors would require a review of the literature for evidence on how they are related to NAU, as well as a methodology and interpretation that take into account possible bidirectional causation. We hope that this study will lay the foundation for future analyses such as these, which are beyond the scope of this paper.

CONCLUSION

Today's adolescent and young adult cohorts are contributing to an acceleration in the prevalence of nonmedical analgesics use. The prevalence is higher among today's adolescents than it has ever been in comparison to adolescent cohorts of the past, and the prevalence is above and beyond an overall "historical period" effect that has increased use among people of all ages. This finding was present among the demographic groups of males, female, non-Hispanic whites, non-Hispanic blacks, and Hispanics.

These findings signal the importance of policies aimed at the young. In this case, the most recent birth cohorts may have developed norms of nonmedical analgesics use that differ significantly from previous generations, and cohort norms have an effect on individual drug use above and beyond the individual's attitudes and beliefs [12]. While past year prevalence does not assess the value or meaning attached to nonmedical analgesics use, it may suggest that there are currently little social costs for engaging in this specific health behavior. These results suggest that current policies and interventions are not yet effective enough to counter the factors that have increased nonmedical analgesics use among U.S. youth and the general population.

Glossary

NAU nonmedical analgesic use

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IMPLICATIONS AND CONTRIBUTION

Today's youth cohorts have a distinctively high prevalence of nonmedical analgesics use, which is above and beyond an overall, general increase that has increased prevalence across all cohorts and ages. New strategies are needed to counter the factors that continue to increase nonmedical analgesics use among U.S. youth and the general population.

Figure 1.
Age, Period, and Cohort Effects for Past-Year, Nonmedical Analgesics Use for Men and Women, All Race/Ethnicity Groups Combined

Figure 2.
 Age, Period, and Cohort Effects for Past-Year, Nonmedical Analgesics Use by Race and Ethnicity
 * note: Analysis excludes Blacks age 60–64 (and as a consequence not enough Information Is available to estimate effects for the 1925–29 birth cohort) because model would not converge when they were Included In the analysis pool

Overall Prevalence of Past-Year, Nonmedical Use of Prescription Analgesics 1985 to 2009, by Sex, Race/Ethnicity, and Age Groups (in Percentages)

Table 1

	Women	Men	White	Black	Hispanic
Ages 15–29					
1985–89	6.31	4.16	6.19	4.46	5.06
1990–95	4.01	4.01	4.50	2.68	3.06
1995–99	3.78	4.97	5.06	2.93	3.00
2000–04	8.38	10.40	11.24	5.32	6.83
2005–09	9.40	11.62	12.86	6.05	7.57
Ages 30–59					
1985–89	2.41	2.74	2.59	2.28	2.83
1990–95	1.96	2.34	2.25	2.10	1.56
1995–99	1.53	1.92	1.81	1.51	1.61
2000–04	3.10	3.21	3.30	2.26	3.59
2005–09	3.34	4.47	4.30	3.07	3.10

Table 2
Age-Period-Cohort Analysis of Past Year, Nonmedical Use of Analgesics: Odds ratios, 1985–2009

	Gender		Race/ethnicity		
	Women (n=405,186)	Men (n=357,144)	White (n=474,715)	Black [†] (n=63,101)	Hispanic (n=129,036)
Birth Cohort					
1930–34	0.65	0.81	0.79	--	0.58
1935–39	0.91	0.59	0.74	0.59	0.40
1940–44	0.93	0.57	0.78	0.76	0.76
1945–49	0.67	0.71	0.61**	1.19	1.25
1950–54	0.79	1.19	0.93	1.02	1.05
1955–59	1.05	1.28	1.08	1.12	1.47
1960–64	1.11	1.08	1.03	1.12	0.98
1965–69	0.99	1.07	0.96	0.97	1.26
1970–74	0.99	0.96	0.98	0.80*	1.01
1975–79	1.03	1.12**	1.11**	0.98	1.06
1980–84	1.35**	1.40**	1.46**	1.12	1.27**
1985–89	1.52**	1.49**	1.60**	1.33**	1.39**
1990–94	1.41**	1.30*	1.43**	1.28	1.28
Period					
1985–89	1.10	1.01	1.01	1.10	1.15
1990–94	0.80**	0.71**	0.75**	0.80**	0.67**
1995–99	0.64**	0.69**	0.66**	0.72**	0.63**
2000–04	1.27**	1.28**	1.29**	1.14*	1.40**
2005–09	1.40**	1.57**	1.54**	1.40**	1.47**
Age					
15–19	1.99**	1.87**	1.91**	1.37*	2.19**
20–24	1.82**	2.23**	2.06**	1.57**	1.87**
25–29	1.36**	1.64**	1.52**	1.39**	1.38**
30–34	1.11*	1.35**	1.27**	1.21*	1.21*

	Race/ethnicity				
	Women (n=405,186)	Men (n=357,144)	White (n=474,715)	Black [†] (n=63,101)	Hispanic (n=129,036)
35–39	1.04	1.01	1.03	1.10	1.05
40–44	0.91	0.88	0.90	0.70**	0.98
45–49	0.70**	0.69**	0.71**	0.66**	0.61**
50–54	0.52**	0.42**	0.45**	0.54**	0.30**
55–59	0.54**	0.43**	0.45**	--	0.77

Estimates denote odds-ratios.

* p<.05;

** p<.01

[†] Analysis excludes Blacks age 55–59 (and as a consequence not enough information is available to estimate effects for the 1930–34 birth cohort) because the algorithm did not converge when they were included in the analysis pool.

Note: The reference group for the cohort coefficients is the mean influence of all cohorts combined, and the reference groups for the period and age cohorts are the mean influence of all periods and ages combined, respectively. For example, a cohort effect of 1.41 indicates that individuals in that birth cohort had odds of past-year nonmedical analgesics use that were 41% than the odds of all cohorts combined.